ENGINEERING AND MINING JOURNAL

JUNE 1961

A McGRAW-HILL PUBLICATION PRICE $1

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Engineered pumping of abrasives corrosives acids

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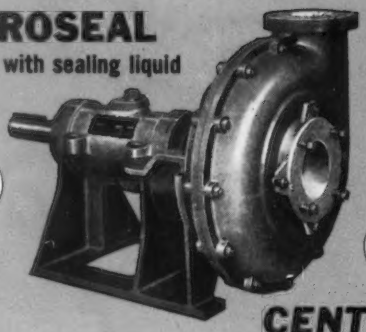
HYDROSEAL
operates with sealing liquid



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CENTRISEAL
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No stuffing box
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Capacities up to 14,000 GPM
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Representatives throughout the World

HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMUM RUBBER PROTECTED

IF PURCHASES ARE ENDORSEMENTS...

P&H is the no. 1 choice of the mining industries

In recent years 68% of all American made 4.5 to 9 yard electric mining shovels bought for use throughout the world have been P&H

P&H has earned such widespread acceptance in the mining industries because of lower per-ton loading cost. This profit premium to owners of P&H Electrics results from these two basic advantages:

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2. **Vastly superior service and parts availability** reflecting our partnership of responsibility to you, the buyers of our products—a partnership of responsibility made possible by our *single source control* of electrical as well as mechanical components and their performance.

Your satisfaction with these advantages has made us The *World's Largest Builder of Full-electric Shovels*. Compare before you buy—write for complete information.

HARNISCHFEGER P&H
Milwaukee 46, Wisconsin

Mining Calendar

Idaho Mining Association, annual meeting, Sun Valley, Idaho, July 5-8

Diamond Drilling Symposium, Broken Hill branch, Australasian Institute of Mining and Metallurgy, Broken Hill, N.S.W., Aug. 21-25

Conference on Metallurgy of Semiconductors, AIME, Hotel Ambassador, Los Angeles, Aug. 30-Sept. 1

11th National Chemical exposition, Chicago Section, American Chemical Society, Chicago, Sept. 5-8

American Mining Congress annual convention, Seattle, Wash., Sept. 11-14

Commemoration of the 50th Anniversary of Froth Flotation in the U.S., sponsored by MBD of SME, Cosmopolitan Hotel, Denver, Sept. 17-20 1961

Northwest Mining Association Convention, Davenport Hotel, Spokane, Wash., Dec. 2-3 1961

AIME annual meeting, New York City, Feb. 18-22 1962

Coming Up

Next month—The third in E&MJ's series of special reports: What the Mining Man Should Know About Power Rectification. Mining ranks near the top of the list of basic industries using electrical power, particularly because of the large quantities of energy used in the manufacture of aluminum and other metals by thermoelectric processes.

Since most of this is in the form of direct current, the next special report should prove a timely refresher course for the mining engineer who might be a little rusty in his electrical engineering.

More cost-cutting—The Cordero Mine, which has bucked as tough a metal market as any producer is likely to meet, will continue its excellent contributions to industry knowledge (they're in this month's issue with a story of the sinking of the Corderito shaft; p 96). Cordero decided the best way to encourage its employees to be cost conscious was to offer bonuses for cost cutting ideas and practices. J. Eldon Gilbert tells the story next month. (Due to last minute change in plans, see p 227.)

From South Africa—The seventh Commonwealth Mining and Metallurgical Congress was held recently in the Union and in Northern Rhodesia. Word has already gotten back about the hospitality of the sponsoring areas and next month's issue will carry a write-up of the papers and the people who participated.

95th YEAR OF PUBLICATION

ENGINEERING AND MINING JOURNAL

JUNE 1961

A McGRAW-HILL PUBLICATION

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SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, Engineering & Mining Journal, 330 West 42nd Street, New York 36, N.Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one or two issues in advance, please allow one month in sending notice for the change to become effective.

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B.F.Goodrich tires haul 40-ton loads of coal to feed a freight train

HAULER FINDS B.F.GOODRICH CP COMPOUND WEARS TWICE AS LONG AS OTHER MAKES

TIME was when razor-sharp rocks and "red dog" on the haul roads at Skygusty, W. Va., ran tires ragged in only 4 months. Tire costs spiraled on the 33 dump trucks operated by Bunch Construction Co. Then the company tried retreading with B.F.Goodrich Cut Protected compound Rock Service tread. These tires have now been in service *eight* months and still have much more tread to go!

If your tires operate in rock, investigate B.F.Goodrich Rock Service tires. You'll find new BFG-developed CP compound shrugs off costly rock cutting, chipping and peeling. You'll find the B.F.Goodrich Flex-Rite Nylon cord construction resists impacts and bruises *twice* as well as conventional materials. Heat blowouts and flex breaks are practically nil. And more tires can be retreaded (Bunch Construction reports Rock Service retreads wear as long as Rock Service original treads).

If your job is as tough as this one (hauling coal 72 hours a week up and down grades as steep as 30%), it will pay you to see your B.F.Goodrich dealer. He'll show you how B.F.Goodrich Rock Service tires with CP (or Heat Resistant or Regular) compound can save you big money. Your dealer is listed under Tires in the Yellow Pages. See him today. *The B.F.Goodrich Company, Akron 18, Ohio.*

Specify **B.F.Goodrich Tubeless or tube-type tires when ordering new equipment**

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NEWS BUREAUS: Atlanta 3; Chicago 11; Cleveland 15; Dallas 1; Detroit 26; Houston 25; Los Angeles 17; San Francisco 4; Seattle 3; Washington 4.

WORLD NEWS BUREAUS: London, Moscow, Bonn, Paris, Rio de Janeiro, Mexico City, Beirut, Tokyo, Melbourne.

WORLD NEWS OFFICES: Stockholm, Manila, Buenos Aires, Caracas, Havana, Lima, Santiago, Montreal, Toronto, Vancouver, Vienna, Johannesburg.

ENGINEERING AND MINING JOURNAL: Published monthly by McGraw-Hill Publishing Co. Inc., James H. McGraw (1860-1918), founder. Printed in Philadelphia, Pa. See panel on p 2 for directions regarding subscriptions or change of address.

Executive, Editorial, Advertising and Subscription Offices: McGraw-Hill Building, 330 West 42nd Street, New York 36, New York. OFFICERS OF THE PUBLICATIONS DIVISION: Nelson L. Bond, president; Shelton Fisher, Wallace F. Traendly, senior vice presidents; John R. Callaham, vice president and editorial director; Joseph H. Allen, vice president and director of Advertising Sales; A. R. Venezian, vice president and circulation coordinator. OFFICERS OF THE CORPORATION: Donald C. McGraw, president; Joseph A. Gerardi, Hugh J. Kelley, Harry L. Waddell, executive vice presidents; L. Keith Goodrich, vice president and treasurer; John J. Cooke, secretary.

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Subscription rates for individuals in the field of publication: United States and possessions $4 a year, $8 for 3 years, single copy $1. Canada $5 a year, $10 for 3 years, single copy $1. Other Western Hemisphere and Philippines $8 a year, $16 for 3 years, single copy $2. Elsewhere $15 a year. $30 for 3 years, single copy $2. Second-class postage paid at Philadelphia, Pa. Title ® registered in the U.S. Patent Office. © Copyright 1961 by McGraw-Hill Publishing Co. Inc. Quotations on bulk reprints of articles available on request. All rights reserved, including the right to reproduce the contents of this publication, either in whole or in part. Our aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome.

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ENGINEERING AND MINING JOURNAL

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JACKSON D. LEONARD

1 FLYGT REPLACES 14 GASOLINE PUMPS

On N.Y. Atlas Missile Site

FLYGT

"Any project where dewatering is necessary to reduce operational costs needs a Flygt", says Frank T. Deane, site supt. for Raymond-Kaiser-Macco-Puget Sound, a joint venture. Mr. Deane having directed operations on several other missile sites in the area speaks from long experience with Flygt. In another statement he said he demanded Flygt pumps when he took over his present assignment at the Mooers Forks site. All told there are 33 Flygt pumps at work around the clock on 12 Atlas missile sites in New York and Vermont. Their job — to keep dry the working area 185 feet below ground level at the silo bottoms. Flygt's 7 model line has been designed for one specific job — to cure your dewatering problems.

PUMP BETTER ELECTRICALLY — USE FLYGT!

57-28

FLYGT Corporation

ORIGINAL MANUFACTURERS OF ELECTRIC SUBMERSIBLE 'DIRTY WATER' PUMPS!

HOOSICK FALLS, N. Y.

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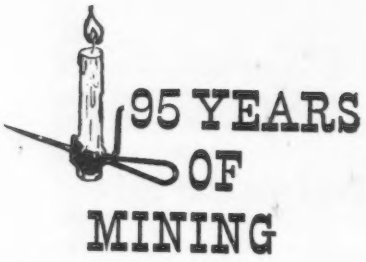


The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became E&MJ.

Scientific Brevities

A new method of finding oil prevails in West Virginia. A shaft is sunk nearly to the rock, and from it drifts are made in every direction, with a grade sufficient to flow the oil to a common centre, from which it is raised by a rotary pump, working at 300 revolutions a minute.

Sea water has a curious action on cast iron, converting it into a grey, porous mass, that grows rapidly hot in contact with air. Some cannons fished up near Scotland became so hot that they could not be touched.

PIT-HOLE CITY, PA., MAY 1866—The RECORD reports a new excitement in the oil regions. A prize concert is soon to take place there, at which $70,000 in prizes are to be awarded. The first prize consists of a hotel, valued at $60,000; the second of a marriageable damsel with $5,000 in greenbacks, and the remaining $5,000 in billiard tables and bank notes.

WASHINGTON, MAY 1866—The President has vetoed the Colorado bill. The reasons he gives are that statistics received after the bill was under discussion show the population of the State to be so small as to render representation in the Senate inexpedient; that this population is actually decreasing; that it would greatly increase the expenses of the Territory if a State Government were introduced; and that it is uncertain whether the people themselves desire a State Government.

COLORADO, MAY 1866—From the Black Hawk JOURNAL: J. Alden Smith has a C & T Desulphurizer pretty nearly ready to run, over on Clear Creek. Mr. Cushman is going ahead with his for the Montezuma Company. Mr. Adams is still running his, and so is the Cook Co., at the Excelsior Mill. It is said that the astute scientists over at Boulder have discovered that gold is not a vegetable nor a vapor, but a "porous substance."

This month in

ENGINEERING AND MINING JOURNAL

Continued from p4

Behind the By-Lines

At one point in our research for this cost issue, a rueful editor observed that some mining companies regard the subject in the reverse of Mark Twain's famous quote about the weather: Everybody does something about costs, but nobody talks about 'em.

But, as it turned out, it wasn't that bad. Many companies were most cooperative; manufacturers told us what they could; individual operators let us have a lot of good stuff; and our own research proved fruitful. Of course, we spend twelve issues a year on the subject of cost cutting and increasing efficiency, but this time we made a special effort to get figures as well as facts.

Once you get through the regular section, we'd respectfully suggest that you begin on p 181, the beginning. It, and the eight pages which follow, serve as an introduction to the Guidebook Issue's basic theme: what it costs to run a mine or plant, and how those costs might be cut. One point, to be found on p 188, points up the necessity for today's mine management to be aware of what goes on beyond the railroad cars at its own plant. The price we get from the metal purchaser can often wipe out the most impressive cost reduction gains at the mine.

The complete Guidebook Section index is on 181.

We've made some changes in the annual Buying Directory, too. It's simpler this year, and printed on colored stock for easy reference. It's no longer necessary to check a separate section for the address of the equipment manufacturer. With the new system, the address is repeated with each mention.

Equipment manufacturers have been canvassed over the past three months and asked for their equipment categories. Their responses were collated and printed by a new method using computer-type machines for speedier handling. The listing is made more functional by the bold face listing (darker type) of advertisers in this issue of E&MJ, keyed to the page on which that company's advertisement is appearing.

We got this one from a university alumni bulletin, of all places. In a speech on the difficult times in which we live, the speaker offered the following example of the challenges of our time.

"There is even confusion at the zoo. I'm told that one day a monkey was observed pacing up and down in its cage with a furrowed brow, a Bible under one arm and a copy of Darwin's "Origin of the Species" under the other. As he paced, he was heard to mutter quietly to himself, "Am I my keeper's brother?"

Lest you think this issue is all Guidebook Section, drop in for an hour or two in pages 85 through 106. That's where the regular June feature articles are to be found. And they, incidentally, make no small contribution to the field of cost cutting themselves.

For instance, there's a three-pager on prolonging the life of drill steel, the story of ammonium nitrate-fuel oil blasting at Sweden's famed Boliden mine, the introduction of cement copper production at Bagdad in Arizona, four pages on the setting up of operating budgets, and how they sank the Corderito shaft. And, for your more contemplative moments, the results of E&MJ's survey of "What the Mining Industry Expects of Its Engineers," with some trenchant comments by leaders of the industry.

THINK BIG

Bigger and better than its predecessors, the QM-5 is designed to make Swiss cheese of granite and to drill holes up to 9" bore size at a rate that will give a production of up to 457 tons per hour with lowest bit cost per unit of production.

New features include angle drilling to 25 degrees, a maintenance-free ejector type dust collector, enclosed operator's cab and full working platforms. Also, choice of famous DHD-500 and DHD-400 Downhole drills for hole sizes from 7½ to 9 inches. Air power is supplied by two Gyro-Flo 900 rotary compressors available in diesel or electric drive.

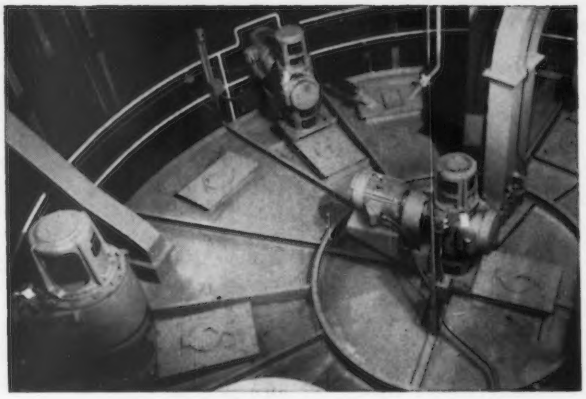
Ask your Ingersoll-Rand sales engineer for the full Quarrymaster story.

Ingersoll-Rand®
QUARRYMASTER

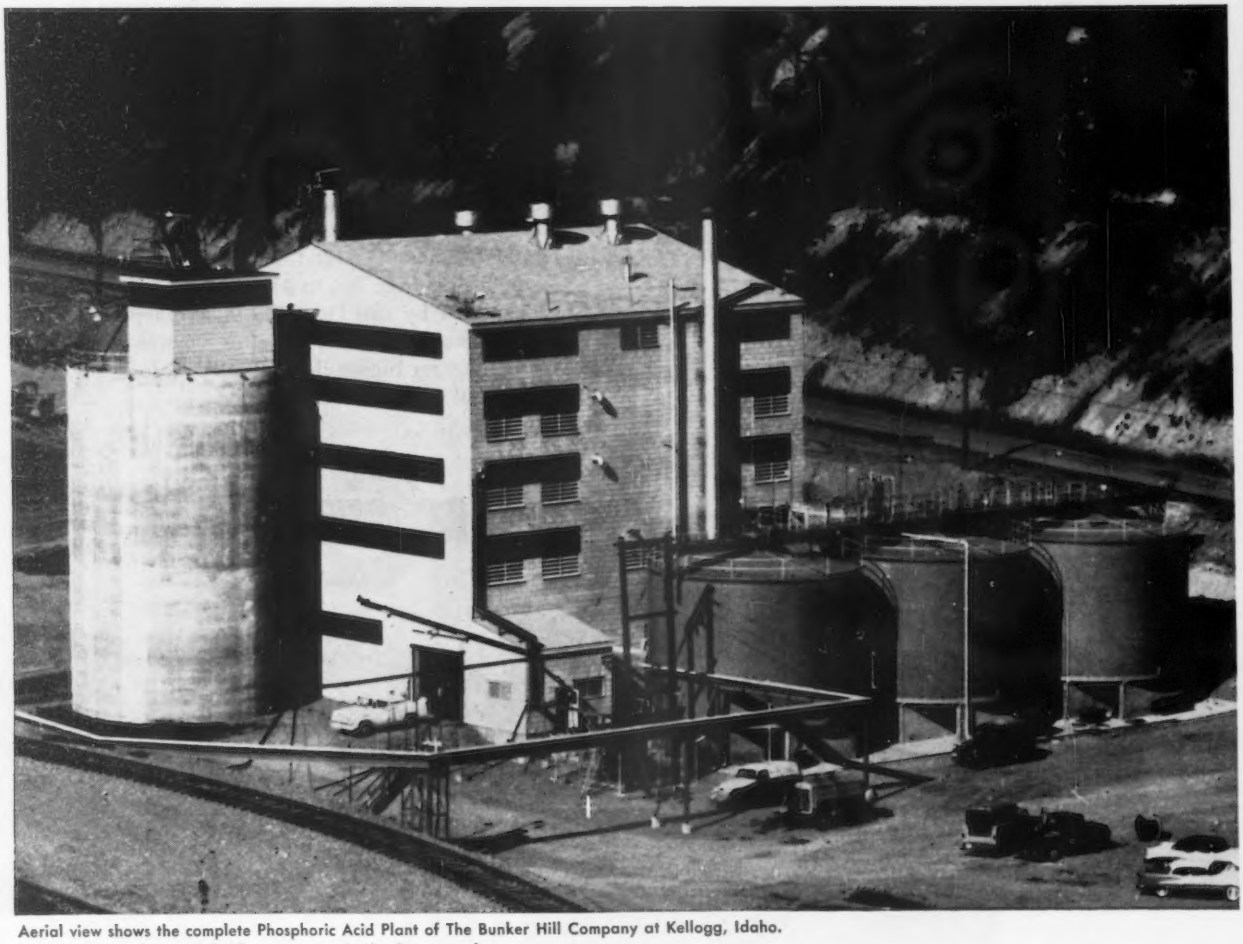
Ingersoll-Rand®
228A5 11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

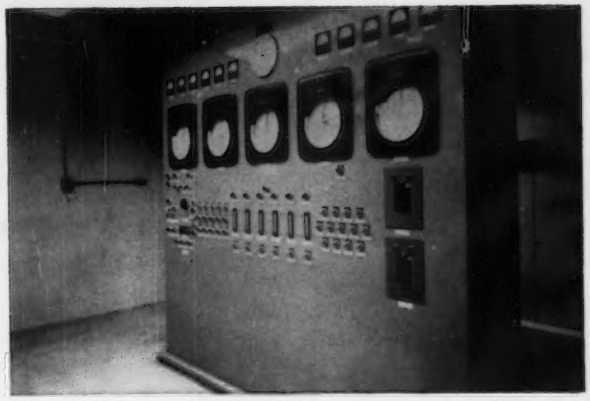
Top view of newly-developed Dorr-Oliver Single Tank Reactor used in this plant for the first time.



SO_2 from zinc plant opens way for

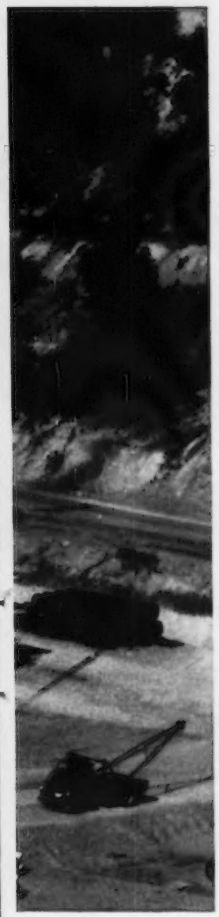


Aerial view shows the complete Phosphoric Acid Plant of The Bunker Hill Company at Kellogg, Idaho. Three 35′ Dorr Storage-Clarifiers are seen in the foreground.



The entire plant operation is controlled from this central instrument panel.

phosphoric acid production at



THE BUNKER HILL COMPANY

Another example of Dorr-Oliver engineering

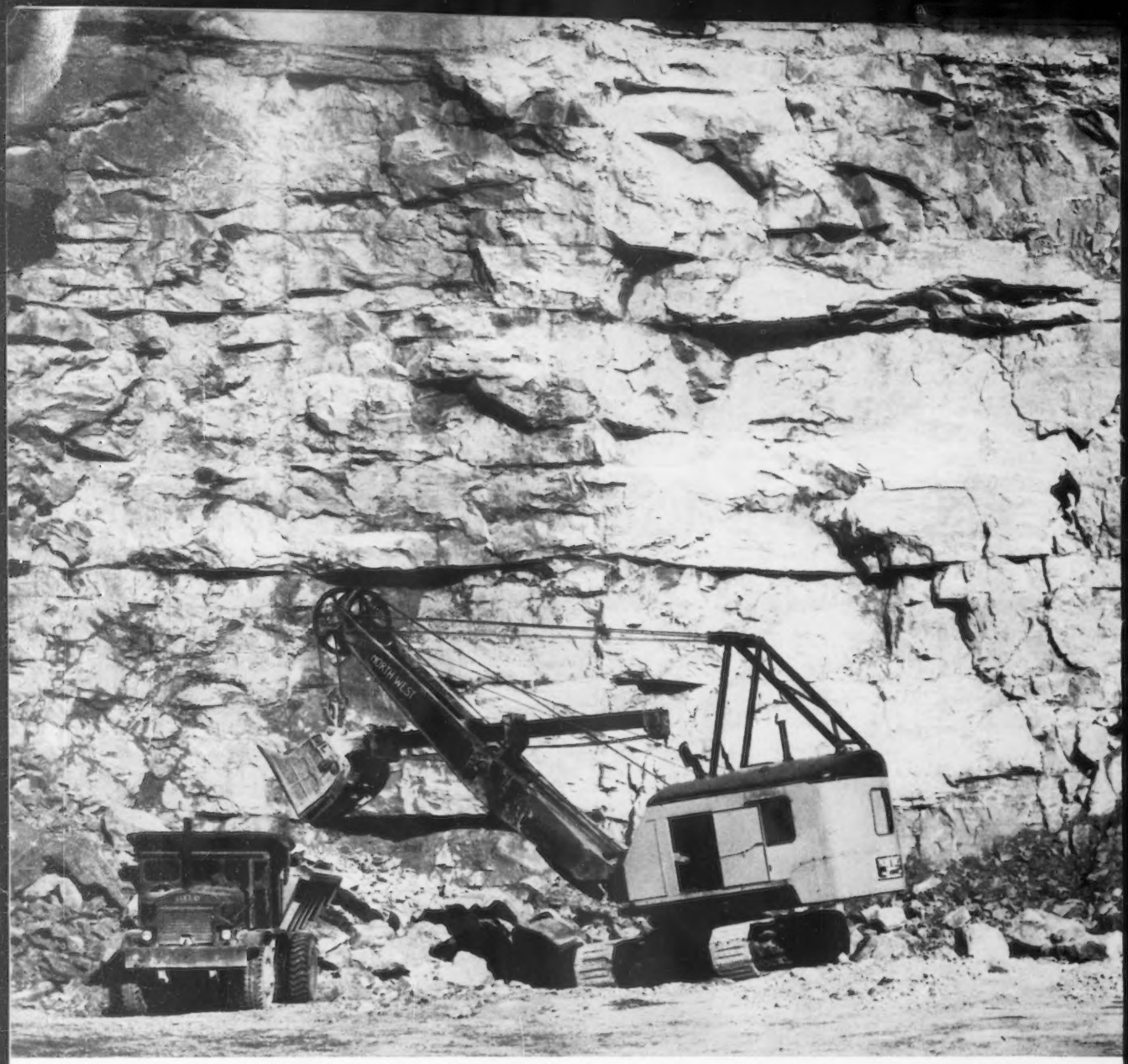
Operated in conjunction with the Company's important zinc reduction facilities nearby, the new Phosphoric Acid Plant of The Bunker Hill Company, Kellogg, Idaho, was constructed in 42 weeks, put into production in January this year, and very quickly achieved capacity and efficient operation. The plant has a design capacity of 130 tpd of 54% P_2O_5 product acid (70 tpd P_2O_5).

The Dorrco Strong Phosphoric Acid Process is used, utilizing Western phosphate rock and sulphuric acid manufactured from SO_2 gas from the zinc plant roasting operation. Complete engineering, plant design, purchasing of equipment and supervision of erection and initial operation were handled by the Dorr-Oliver organization.

Selection of Dorr-Oliver was based on over 40 years of experience in constructing wet process P_2O_5 and complete fertilizer plants throughout the world. For information on the complete range of D-O engineering services available to the Fertilizer Industry, write to Dorr-Oliver Inc., Stamford, Connecticut.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT



25% additional service with Yellow Strand "POWERSTEEL" at Watauga Stone Co.

"Rugged" is the only way to describe the job of digging rough shot rock out of this Tennessee quarry. It takes rugged equipment to match the job and for this reason, Watauga Stone Co., Carter County, Tennessee, specifies Yellow Strand "POWERSTEEL" Wire Rope.

Hoist and crowd lines take quite a beating—they used to last 3 weeks on this big 2½ yd. shovel. Three years ago Watauga tried—and liked—Yellow Strand "POWERSTEEL" Wire Rope. They found Yellow Strand "POWERSTEEL" runs an average of 4 weeks—6 days per week, 8-hour shifts—between hoist and crowd rope changes. They report, "We're more than satisfied with Yellow Strand "POWERSTEEL."

25% longer life is an excellent average. B & B's extra high strength rope is designed for heavy loads and abrasive conditions. It's available right now from your Yellow Strand Distributor. Call him! *Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.*

Yellow Strand®
"POWERSTEEL"®
WIRE ROPE

GOODYEAR

Q: What do Goodyear Earthmover Rims have that no others have?

A: MORE times FOUR

1. MORE rims on the job: More tons are hauled on—more earth-moving equipment rides on Goodyear rims than on any other kind. Result: You reap the benefits of the widest, soundest experience in rim design, manufacture and use.

2. MORE kinds of rims: Maximum rim performance stems from proper specification. Goodyear makes the *only complete line* of earthmover rims. Result: The choice that permits you to get exactly the right rim for the job.

3. MORE rim engineering help: Goodyear has more engineers designing *and selling* rims than any other company. And they know tires, too. Result: The help you need in choosing the right rim for top performance—longer tire life.

4. MORE rim "firsts": The first *true* earthmover rim, the first 5° rim, the first tubeless rim—in fact, every major earthmover rim advance was made by Goodyear. Result: The very latest in rim design and manufacture at work, for you.

What better reasons for choosing Goodyear as your rim supplier? Only these: The desire and ability to design and build any rim that may be needed for *tomorrow's* earth-moving equipment. No matter what your rim needs or plans, you'll find it pays to call on Goodyear. See your local rim distributor, or write: Goodyear, Metal Products Division, Akron 16, Ohio.

Lots of good things come from

GOODYEAR

This mark tells you a product is made of modern, dependable Steel.

Now Available...

USS QUENCHED AND TEMPERED STRUCTURAL SHAPES

in such grades as "T-1", "T-1" type A, 9% Nickel and HY-80 Constructional Alloy and Armor Steels

Announcing another industry "first" for United States Steel—USS Quenched and Tempered Alloy and Armor Steel Structural Shapes are now commercially available for the first time anywhere, in the types and sizes shown in the accompanying tables. The more commonly used sizes of American Standard Beams, Channels, Equal Angles and Unequal Angles will be produced in these USS Steels: "T-1", "T-1" type A, 9% Nickel, HY-80 and certain other alloy grades that provide desirable mechanical properties after quenching and tempering. Later, other sizes and shapes will be added according to demand.

These quenched and tempered alloy and armor steel structural shapes (see table below) can simplify design and result in substantial weight savings, increased structural strength and reduced shipping and handling costs. For a free folder about any of these steels or their structural shapes, contact your local USS representative or write to United States Steel, Room 6314, 525 William Penn Place, Pittsburgh 30, Pa. USS and "T-1" are registered trademarks

United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal & Iron Division • United States Steel Supply Division • United States Steel Export Company

Availability Quenched and Tempered standard structural shapes are available in the following shapes and sizes:

I	Beams: 6″ to 12″ inclusive	American Standard Sections and Foot Weights*
[	Channels: 6″ to 15″ inclusive	American Standard Sections and Foot Weights*
L	Equal Angles: 3″ to 8″ inclusive	Standard Sections*
L	Unequal Angles: 3½″ x 3″ to 8″ x 6″ inclusive Maximum Length 40′ for all sections	Standard Sections*

*See our booklet, "USS Shapes & Plates," ADUCO-27001

Mechanical Properties of Quenched and Tempered Alloy and Armor Steel Structural Shapes

	Yield Strength, psi	Tensile Strength, psi	Elong. in 2″, % min.	Reduction of Area, % min.	Longitudinal Charpy Impact (when specified)	
					Keyhole	V-notch
"T-1" Steel 2½″ and Under	100,000 (min.)	115,000/140,000	18	55①	15 ft.-lbs. @ −50F	30 ft.-lbs. @ +10F
"T-1" type A 1″ and Under	100,000 (min.)	115,000/140,000	18④	45③	15 ft.-lbs. @ −50F	—
Grade A 9% Nickel	60,000 min.	90,000 min.	22% min.	—	15 ft.-lbs. @ −320F	20 ft.-lbs. @ −320F
Grade B 9% Nickel	65,000 min.	95,000 min.	20% min.			
HY-80 ¼″-2″ Incl.	80,000/100,000②	—	19④	—	—	70 ft.-lbs. @ −120F

①¾″ and under—45% min.
②½″ and over, yield strength range is 80/95,000 psi
③¾″ to 1″ inclusive, elongation 16% min.
④½″ to 2″ inclusive, elongation 20% min.
⑤¾″ to 1″ inclusive, 55% min.

USS United States Steel

THE TOUGHEST SHOVELS BUILT...

...and the SMOOTHEST!

ANY shovel can dig *dirt!* But what is your output going to be in a job like this? Your Northwest is a *real* Rock Shovel. It's been proved over and over again. Begin with the foundation—Machinery Bases of alloy cast steel with cast steel machinery side frames—massive—capable of amply withstanding the wracking, twisting strains of rock digging—a base that frees you from periodic rebuilding.

Get on a Northwest! Get the feel of the controls. Feel that crowd take ahold. Find out what it means to watch that dipper bite up through in one smooth cut. Here is a combination—the Feather-Touch Clutch Control that brings ease of operation with the Northwest Dual Independent Crowd—a combination that brings a smoothness of maneuverability in handling the dipper the like of which you have never experienced before.

The Northwest Dual Independent Crowd utilizes force most independent crowd shovels waste. The Cushion Clutch eliminates shock overloads on operating machinery, Northwest design assures easier upkeep. These are just part of the many advantages that Northwest brings you for high output in rock work. They mean savings in time! They make money and assure your ability to take care of the unexpected. They combine to make the Northwest the finest machine of its kind.

Make your next machine a *real* Rock Shovel—a Northwest.

NORTHWEST 3/4 to 3 Cu. Yd. Capacity

CRANES • SHOVELS • DRAGLINES
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S-SD-14-LC

'61 FORD TANDEM AXLE TRUCKS

BROADER WARRANTIES... GREATER DURABILITY... BIGGER CHOICE!

FORD DIVISION, *Ford Motor Company*

FORD HAS WARRANTED TO ITS DEALERS, WHO IN TURN WARRANT TO YOU:

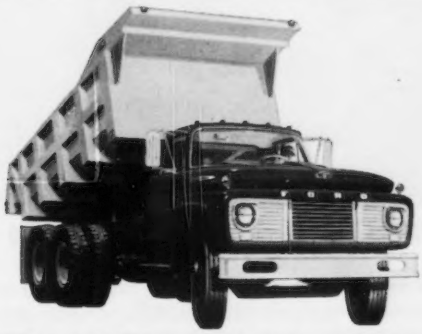
- **New Super Duty V-8 Engines for 100,000 miles or 24 months!**
- **New Ford Trucks for 12,000 miles or 12 months!**

Ford's rigid quality control program gives you unsurpassed dependability! Positive evidence of uniformly high production and inspection standards is the exclusive new 100,000-mile engine warranty. On 401-, 477- and 534-cu. in. Super Duty V-8 engines, each major engine part (including block, heads, crankshaft, valves, pistons, rings), when engine is used in normal service, is warranted by your dealer against defects in material or workmanship for 100,000 miles or 24 months, whichever comes first. Warranty covers the full cost of replacement parts . . . full labor costs for the first year or 50,000 miles, sliding percentage scale thereafter.

In addition, an extended warranty covers all 1961 Ford Trucks of any size. Each part, except tires and tubes, is now warranted by your dealer against defects in material or workmanship for 12 months or 12,000 miles, whichever comes first. The warranty does not apply, of course, to normal maintenance service or to the replacement as normal maintenance of such items as filters, spark plugs and ignition points. *No other trucks give you such protection for your investment; never before could you be so confident of long-range durability!*

Tougher tandems offer greater strength in chassis, cab and sheet metal for longer life. Full-Torque flywheel power take-off is available for more efficient drive of transit mixers and heavy-duty equipment.

Timken or Eaton rear axles, with capacities up to 38,000 lb., are available in all Super Duty tandems. High capacity front axles have wider track for increased stability when cornering or in rough terrain.



GVW's up to 51,000 pounds permit big, profitable payloads. Heavier gauge metal and stress-isolating independent mounting for radiator, fenders and cab give you greater durability.

Tandem Axle models are available with tilt cabs. As with conventional tandems, aluminum walking beams, wheels and fuel tanks are offered to cut weight . . . increase payload capacity.

QUALITY-BUILT... MAINTENANCE-ENGINEERED

FORD TRUCKS COST LESS

CRAWLER-MOUNTED C-350

MEET A MINING MAN'S DRILL... THE ALL-NEW ALL-HYDRAULIC 350 REICHdrill

TRUCK-MOUNTED T-350

NOMINAL HOLE SIZE—1⅞" TO 5⅝" ● DOWN PRESSURE—10,000 LBS. ● ROTARY SPEED TO 540 RPM

Here's the ultimate in a mobile drilling rig for holes to 5⅝" ...the all-new 350 REICHdrill.

Job performance records under extreme drilling conditions have proved the cost-cutting advantages of its all-hydraulic features: Rotary Top-Drive; Precise Feed Pressure Control; Fast-acting Levelling Jacks.

The 350 moves in quickly...sets-up fast, breaks footage records on every shift. Handles 3-cone rotary bits, in-hole drills, diamond core bits, wire line tools, or drag bits.

C-350 Crawler-Mounted REICHdrill is unmatched for maneuverability and stability. Trams easily at almost 8 mph ...can climb a 25% grade...turn in its own length. Low center of gravity...wide tracks help it meet and beat any tough terrain.

T-350 W Truck-Mounted REICHdrill has all the time-saving, cost-cutting hydraulic features of the crawler-mounted unit. Offers complete mobility...saves schedule-killing time on moves between drilling sites.

Ask for SP-5001-2

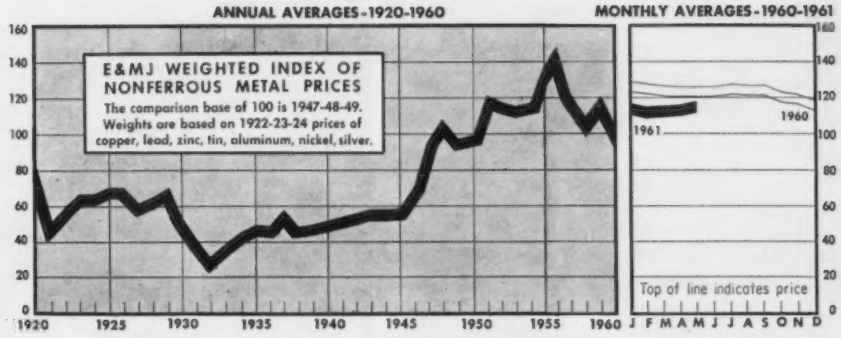
REICHdrill

FRANKLIN (VENANGO COUNTY), PENNA.

Division: CHICAGO PNEUMATIC TOOL CO.

E&MJ OUTLOOK

PRICES



MARKETS

E&MJ's nonferrous metals price index jumped from 115.8 in April to 118.5 in May. A 1.4¢ price increase for copper, and 3¢ for tin accounted for the rise to highest level since December.

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AT HOME

An Administration move to eliminate legal requirements of 25% gold backing for Federal Reserve System liabilities was stopped cold by a flood of opposition. See editorial p 85 and Washington Impact, p 20.

Compact cars, which accounted for nearly 30% of the automobile output for 1960, are blamed by the American Die Casting Institute for the disappointing volume of production of die castings.

High labor and capital equipment costs in the U.S. and "antique" depreciation provisions and foreign trade barriers have combined to cut the steel industry's participation in foreign markets by about 85% in the past 13 years, according to Logan Johnston, president of Armco Steel Corp.

Sunshine Mining Co., of Idaho, is centering exploration efforts on potential silver properties in the Western Hemisphere. R. M. Hardy, Jr., president, says the long-range outlook for silver is better than for nonferrous metals.

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LABOR

In an open letter to David McDonald, president of United Steel Workers, John Clark, president of Mine-Mill, charged that the Steel Workers had spent millions of dollars to take over jurisdiction of Mine-Mill in the nonferrous metals industry.

Mine-Mill is pushing for a 32-hr week at 40-hr pay. See Labor This Month, p 21.

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ABROAD

British and Canadian aluminum experts are discussing plans to establish an aluminum smelter in Queensland. Investigations are on behalf of Australian Aluminum Co., Ltd.

Contracts with Japan will swell the value of minerals to be supplied by British Columbia producers by more than $220-million in the next 10 years.

India's third five-year plan proposes to increase aluminum output from 85,000 tons per year by 1965 to 135,000 to 150,000 tpy. In addition to the Kaiser plant now being built, Reynolds, Alcoa and the Hungarian government are reported to be interested in participating.

Companhia do Vale Rio Doce, Brazil's leading iron ore exporter, has approved a contract with Acesita S.A. steel mills under which the former will develop two of the latter's ore properties over a ten-year period. The properties are reported to contain about 25-million tons of 68% iron ore.

International Iron of Costa Rica, Inc. is initiating development of iron ore-bodies in Nicoya Peninsula totaling 220-million tons of 25% to 65% iron.

THIS MONTH IN MINING

KARL JASPER, president of Grandview Mines, chats with Mrs. Carlos Milner and Mrs. Eskil Anderson over coffee.

RALPH WATSON, left, geologist for the Great Northern Railway, compares notes with Dean Earl F. Cook of Idaho.

Pacific Northwest Meeting Attracts Area Leaders

THE NATION'S petroleum supply, the geology of the Pacific Northwest, secondary metalworking in atomic and space age industries and recent mining industry developments in northern Idaho were among the topics discussed at the Pacific Northwest Metals and Minerals Conference in Spokane April 13-15.

The conference, sponsored by the Columbia section of AIME and the Inland Empire Chapter of the American Society of Metals, drew more than 200 engineers and industry representatives.

Lloyd E. Elkins, president-elect of the AIME and production research director of Pan-American Petroleum Corp., Tulsa, Okla., told an April 14 luncheon meeting that America's supply of crude oil, together with some imports, would be adequate to take care of the nation's needs for at least 50 years. He predicted that improved technology will make it possible to boost the recovery efficiency in the oil industry. He said so far the industry has discovered about 310-billion barrels of oil in the U.S. The industry has produced in the past or can recover with present methods about 105-billion barrels. He said that in the next 50 years the industry probably would discover another 150-billion barrels, boosting the total to 450-billion. Improved technology, he said, could be expected to boost the recovery to 250-billion, or about 60% as compared with the present recovery rate of one third.

An increase in iron ore production in Idaho was predicted by David W. Young, of the Idaho Bureau of Mines and Geology. He said Idaho produced only 1443 tons of iron ore in 1958. This increased to 5500 tons in 1959 and 8807 tons in 1960. He indicated the state's production has always been relatively small but said it could go up sharply if mining begins in Lemhi, Latah and Custer Counties this summer. New information on iron ore deposits in the state already has been disclosed in a cooperative study which has been started by the Idaho Bureau of Mines and Geology and the U.S. Bureau of Mines, he said.

LLOYD E. ELKINS, president-elect of AIME, was a luncheon speaker.

H. G. Schlicker, engineering geologist with the Oregon Department of Geology and Mineral Industries, told the group that rapid urban expansion is beginning to conflict with the development of mineral resources. He said that for each 1-million increase in the population it is estimated that 160,000 new acres of land will be absorbed into metropolitan use. Much of this land, he added, would be drawn from present uses, including extraction of minerals. He cited six commercial mineral developments in California which have been forced to shut down because of urban expansion.

V. C. Wansborough, Toronto, vice president and managing director of the Canadian Metal Mining Association, told the group at a panel discussion on gold that Canada, with a large stake in the gold industry, is increasingly anxious for a key to a solution to the present gold crisis in the U.S. He suggested that a price increase would be helpful. Such a step, he indicated, would enable gold to do a better job, particularly in its role in international payments.

A series of sessions on secondary metalworking featured papers presented by a group of General Electric Co. scientists and engineers at Hanford Works, Richland, Wash. They outlined recent developments in metallurgy and ceramics in fuel fabrication and fuel development at the atomic plant. A description of new methods developed for high energy impact forming of UO_2 was presented by D. W. Brite, GE engineer in ceramic fuel development, R. J. Anicetti, senior scientist in ceramic fuel development, and R. G. Wheeler, senior engineer in fuel design.

New techniques in forming metals

were outlined by two Boeing Airplane Co. officials. They were Frank Sutch, engineer in the manufacturing development section, and E. L. Stone, project chief in the section. Another Boeing man, D. A. Honebrink, process engineer in the aerospace division, described fabrication of structural parts from molybdenum-½% titanium sheet.

Research work by the Spokane research office of the U.S. Bureau of Mines was outlined in a paper presented at a session on concrete. George T. Krempasky and Webster S. Anderson, mining methods research engineers, decribed recent work on precast concrete sets, including a new eight piece concrete set developed at the Spokane office.

Robert P. Corbett, Anaconda Co., Butte, Mont., cited the application of concrete for underground support at the Kelley mine, and A. G. Stirling, operating superintendent of the Sullivan mine of Consolidated Mining and Smelting Co. of Canada, Ltd., described concrete practices at the Sullivan mine near Kimberley, B. C. Sinking of a concrete shaft was the topic of a presentation by H. G. Young, manager of operations for Boland Construction Co., Toronto.

John A. Laberee, manager of the Pacific District of the Extension Division of E. I. du Pont de Nemours & Co., was the April 13 luncheon speaker. He warned that the enemies of America can destroy it by getting it to destroy its own productivity. He said enemies have threatened the U.S. with economic burial. To make good on their threat, he added, they need only to effect changes in the social structure so that the producer fares no better than the parasite, the saver fares no better than does the spendthrift.

"There is nothing mysterious about America's plenty," he said. "It's simply because we have learned to produce and distribute economic goods in abundance."

New Be Firm Is Formed; Brush Doubles Capacity

FORMATION of a new beryllium company, Beryllium Metals & Chemicals, has been announced by Lithium Corp. of America and Alloyd Corp., Cambridge, Mass. The new firm, with a plant near LCA's operation at Bessemer City, N.C., will engage in research and in the purification and production of beryllium metals and chemicals. Production is expected in late 1962.

In another announcement, Brush Beryllium said it would expand metal production capacity at Elmore, Ohio, to more than 30,000 lb per month from the present 12,000-lb level. The increase is a result of a $6-million expansion program.

(This Month continues on p 290)

As We Went to Press . . .

Consolidated Mining & Smelting Co. of Montreal and Trail, B.C. may build a $4-million phosphate mining and processing project in Montana. Fred E. Burnet, vice president of Montana Phosphate Products Co., Deer Lodge, the Cominco subsidiary which would operate the mine, has announced that preliminary tests have been encouraging and a large-scale pilot plant test is now under way.

Investigation of the deposits, in Granite County, has been going on for several years, Burnet indicated. The property was acquired from International Minerals & Chemical Co.

The deepest single shaft in the world is claimed by Western Deep Levels (Transvaal) at its No. 3 ventilation shaft, which has reached 7289 ft. The shaft will use a large Koepe hoist to move rock in 15 skips from a depth of 6200 ft.

Natomas Corp. will begin a gold dredge operation in Peru as soon as clearance from the government of Peru is obtained. In its first foreign venture, Natomas will invest $1.2-million in the dredging operation in the Poto River basin, district of Puno, in the high plateau region of southern Peru.

The Minnesota Legislature has turned down the iron ore industry's request for Constitutional guarantees of tax equity treatment in the construction of taconite plants (see p 328). While affirming "legislative policy" to continue tax incentives, the state officials refused to pass the Constitutional addition.

Hidden Splendor Mining Co.'s A. Payne Kibbe has announced purchase of controlling interest by his firm in asbestos properties in San Benito County, Calif., and a contract for the lease of silver-copper prospects in the Sunlight Basin of Wyoming. The asbestos lands had been controlled by Basic, Inc. of Coalinga, Calif. and the Ag-Cu prospect by Skyline Corp., of Powell, Wyo. Kibbe emphasized that the latter is a "raw prospect" which is now being evaluated by a team of geologists.

Anaconda Co. expects to know "within the next few months" whether it will continue work on the Mt. Washington beryllium prospect in Nevada, according to Clyde E. Weed, chairman of the company.

The firm has been "reasonably encouraged" by results to date, Mr. Weed said, but noted that development of "a million or so tons" would be necessary for the deposit to meet expectations. Mr. Weed also noted that the ore is a beryllium silicate, and contained no aluminum ores.

Exploration work in the vicinity of the Glacier Peak copper property in the Cascade Mountains of Washington will be curtailed by Bear Creek Mining Co. because of "uncertainties" over the creation of the Glacier Peak Wilderness Area. The Kennecott subsidiary has been investigating the property for several years and believes a major copper deposit exists in the area.

Howe Sound Co. is reported continuing negotiations with the port of Portland for a proposed site at the confluence of the Willamette and Columbia Rivers for a $25-million aluminum reduction plant.

WASHINGTON IMPACT

Highlights

THE GOLD DRAIN scare of 1960 took place largely while Washington and the nation were concerned primarily with Presidential elections.

As a result, official Washington has not until recent weeks gotten around to looking at the subject of gold in a legislative light.

Congress now is studying gold from two views — one, backed by the Administration, to remove the legal requirement of 25% gold backing for liabilities of the Federal Reserve System; the other, opposed by the Administration, to provide Federal incentive payments up to $35 per ounce for domestic gold producers.

GOLD RESERVE HEARINGS in the House failed to get off to a quick start. Secretary of Treasury Douglas Dillon and William McC. Martin were scheduled to be the initial witnesses at hearings before a House Banking Subcommittee, but the hearings were postponed indefinitely when an unexpected flood of opposition developed around the country and was reflected in some Congressional quarters. There were reports that Dillon and other high-ranking Administration officials believe some groundwork must be laid in Congress before the hearings get under way.

The Administration has taken the position that the entire U.S. stock of gold is available in any emergency to back up the dollar, but that the legal requirement of 25% backing should be eliminated to remove any possible doubt that the U.S. can meet its requirements.

Only twice since the Federal Reserve System was established almost 50 years ago has the gold holdings level come close to the required legal ratio. In 1945, when post-war international problems lowered U.S. gold holdings, the requirement was lowered to the present 25%.

There is some strong sentiment in Congress for maintaining the reserve requirement. The major reason given by opponents of the Administration plan is that the 25% requirement restrains inflationary policies. Mining groups are opposing elimination of the 25% requirement. Mining-state Congressmen are fearful that removal of the limitation would harm prospects of stabilizing U.S. gold production.

REP. ABRAHAM MULTER (D., N.Y.), chairman of the House Banking Subcommittee studying the gold requirement, is also sponsor of the House bill which would remove the limitation.

"The bill would reemphasize our determination to maintain the value of the dollar at the present ratio of $35 per oz of gold," Multer said. "It is well at this time to repeat that our Government has no intention of devaluing the dollar."

The proposed legislation is in line with Pres. Kennedy's special message to Congress on the balance of international payments, in which he pledged to put the full weight of U.S. gold reserves, including those held as currency backing and U.S. resources in the International Monetary Fund, behind the dollar. Kennedy did not specifically request, however, that the 25% gold cover be lifted.

Around a corner in the House Office Building, another Subcommittee is considering a bill to set up subsidies for domestic gold producers.

Main backers of the bill include Reps. Ralph J. Rivers (D.,Alaska), Gracie Pfost (D., Idaho), Harold T. Johnson (D., Calif.), Arnold Olsen (D., Mont.), E. Y. Berry (R., S.D.), Harlan Hagen (D., Calif.), and J. Edgar Chenoweth (R., Colo).

Administration opposition to the Rivers bill, which would set payments of $35 an oz to operators of new or reopened mines and $20 an oz to operating mines, came in testimony from a USBM official.

"The executive branch is opposed to the enactment of any legislation that would establish or imply a second price for gold, different from the $35 per oz price now in effect," Merrill said.

The Interior official testified that incentive payments would force the Government to pay, in effect, $70 an oz for gold which could then be purchased for $35 an ounce by foreign governments and US. industrial users. He said the Interior Department recognized that the subsidy bill would benefit domestic gold miners, but that the executive branch believes the national interest lies in maintaining the present price without subsidization.

Latin-U.S. Trade Plans May Affect Lead and Zinc

THE ADMINISTRATION is turning once again to its "alliance for progress" as the major weapon against Castroism in Latin America, and the possibility of lead and zinc commodity agreements is being studied in this light.

With hopes virtually abandoned for an inter-American foreign ministers meeting designed to isolate Cuba from the hemisphere, U.S. officials are now pinning their hopes on the Organization of American States meeting July 15 in Montevideo, Uruguay.

President Kennedy has ordered the State Department to determine whether some firm proposals on commodity agreements can be made by the U.S. at the Montevideo meeting.

Commodities being studied by U.S. officials include lead and zinc, cocoa, and coffee. In the past, the U.S. generally has shied away from commodity agreements, but President Kennedy said in his Latin message to Congress that his Administration would take a new look at the possibilities.

Should the Montevideo session look with favor on potential lead and zinc agreements, the U.S. would be under heavy pressure to abandon its present lead and zinc import restrictions.

U.S. officials do not expect to propose any copper agreement at the Montevideo meeting, although Chile and other nations have suggested various programs to stabilize prices and production of the metal.

Two main reasons are given for the reluctance to consider copper: First, the copper market has improved considerably during the first part of 1961.

Secondly, most major copper-producing companies are U.S.-owned and subject to U.S. antitrust statutes. The Justice Department has taken a dim view of the Chilean proposal and of a suggestion by Senate majority leader Mike Mansfield (D., Mont.) for a world "cartelization of sorts" for copper.

Kennedy Tax Cut Plan Meets New Opposition

CONGRESS is in the midst of a fight over what type of business tax relief, if any, should be passed this year.

The House Ways and Means Committee plans to continue hearings through about mid-June on the Administration proposal for a special tax credit plan designed to stimulate spending on plants and equipment.

But a growing number of lawmakers are opposed to the Kennedy recommendation, and are urging instead a program of increased depreciation values.

Mining spokesmen told the House Committee that Kennedy's tax plan should not be adopted until depreciation

provisions are changed "to furnish more adequate and realistic allowances for the recovery of capital cost."

The Administration proposal, formulated mainly by Assistant Secretary of Treasury Stanley Surrey, would allow a taxpaying company, individual, or partnership to deduct from its final tax bill up to 30% of tax-year expenses on plants and equipment after Jan. 1, 1961.

Area Redevelopment

THE COMMERCE DEPARTMENT is readying one of the Administration's first major domestic programs—area redevelopment.

Soon after President Kennedy last month signed into law the area redevelopment act, Commerce created the new area redevelopment administration.

Secretary of Commerce Luther H. Hodges tapped William L. Batt, Jr., Secretary of labor and industry for Pennsylvania, to head the new organization.

Once an area is designated for redevelopment, most of the initiative lies with local leaders. The depressed community must draw up an over-all economic development plan which must be endorsed by the state and approved by Washington officials before any aid can be rendered.

Under the program, $200-million is set aside for industrial and commercial loans. The money can be used, for example, to build new plants, rehabilitate abandoned structures, or enlarge others. Main criterion for use of the money is to attract or expand business which can employ local workers.

Although many of the first areas to be designated for redevelopment are in the urban areas of the east, a number of mining-area cities and towns are expected to be included in the program.

GAO Attacks Hanna Contract

THE GENERAL ACCOUNTING OFFICE is critical of some nickel-producing contracts between the Federal Government and the M. A. Hanna mining companies.

Contracts with three Hanna companies were executed in 1953 under the Defense Production Act to expand the productive capacity and supply of nickel.

The contracts now have been fulfilled and a smelter in Riddle, Ore., for which the Federal Government paid $22-million, returns to Hanna under the terms of the contract for about $1.7-million, the estimated salvage value of the facility (E&MJ, May p 19).

Government auditors, who believe the U.S. should receive more than salvage value for the plant, want the General Services Administration to negotiate with Hanna for extra payments to the Government if commercial operations are continued at the smelter.

Labor This Month

KENNECOTT — A TEST CASE: The Mine, Mill and Smelter Workers are staging a preview of their industry-wide negotiations in 1962 with the Kennecott Copper Corp. Demands served on Kennecott to replace labor agreements running out at the end of this month may set the two-year pattern. Top goal, a 32 hour week at 40 hours pay; retirement at age 65 instead of the current 68 years; higher supplemental unemployment pay and health and welfare benefits. Mine-Mill, representing nearly 5000 Kennecott workers, has already laid out this same set of demands for the rest of the industry next year. Unless the current bargaining teams settle on a one-year contract, you're likely to get an advance look at future copper labor agreements.

AUTOMATION DISILLUSIONMENT AND HOPE: The United Packinghouse Workers, a union frontrunner in the race for job protection against automation has devised new goals. Two years ago, an agreement between Packinghouse and Armour and Co. provided a $500,000 company-paid automation fund to help cushion the effects of automation on union employees. But the results — a professional study of automation and retraining programs for some Armour employees — have been "disappointing" to Packinghouse president Ralph Helstein. With new Armour negotiations coming up this summer, Helstein's union will drop the fund idea and substitute these new demands:

A ban on packing plant closings during the life of the contract.

For each worker with five years' service, a 13 week "sabbatical" leave with pay to train for another job outside the industry.

Guaranteed pay for the employee during the life of the contract.

GOVERNMENT PUSHES LABOR REFORM: With barely a ripple in public, Federal investigators have settled 1200 cases under the Landrum-Griffin reform law by voluntary compliance on the part of the union leaders. Only 25 complaints by workers against labor unions have gone to court—mostly involving charges of fraudulent elections. Reform chief John Holcombe, head of the Bureau of Labor-Management Reports, cites a typical case: when members of United Steelworkers Local 1617 in Youngstown, Ohio, complained of ballot-stuffing in a local union election, Holcombe's team uncovered the evidence. With the help of the Steelworkers' international officers, a new election was run off. The local president who won by an 809 to 623 count in the first vote was defeated by 933 to 321 in the second. Some members counted in the first balloting weren't even in town for the election.

So far, the Bureau has filed charges against management in one case. Labor Secretary Arthur Goldberg has asked U.S. District Court to compel the Olson Rug Co. of Chicago and the Illinois State Detective Agency to file reports to the Bureau. Goldberg charged the parties refused to report on an agreement by the Detective Agency to furnish the employer with information on workers involved in a labor dispute.

OVERWORKED NLRB SEEKS RELIEF: Facing a mounting number of complaints filed by employers and unions, NLRB chairman Frank McCulloch wants a drastic overhaul of the Federal labor agency. "After two months in office we are further behind, in spite of hard work," he says, noting that unfair labor practice charges are coming in at 23,000 rate annually compared with the past average of 13,000 a year. What McCulloch wants, with President Kennedy's backing, is to transfer the Board's authority to decide such cases to the NLRB's 64 trial examiners. This would require Congressional approval since the Taft-Hartley Act requires the five-man Board to make the decisions.

MINE-MILL CHALLENGES WHITE HOUSE: Despite their support of the Kennedy Administration, MMSW officials complain its anti-recession program is ineffective. Mine-Mill president John Clark told Congress the President's plans for tax incentives for business "hasten the process of automation, speed up the displacement of millions of workers and swell the ranks of the technologically unemployed. It is a flagrant case of putting the cart before the horse."

MARKETS

Copper Price Raised to 31c, Some Sales Higher; Zinc Premiums Cut to Fight Discounts; Tin Jumps

THE E&MJ INDEX OF NONFERROUS Metal Prices moved up nearly a full 3% in May to 118.5% of the 1947-49 average. After three months at 29c, copper prices rose 2c on the producer level, with smelters higher. Tin, which jumped about 4c in April, continued its climb in May, hitting $1.10—a gain of 3c over April. All other index metals were unchanged over the period.

The copper market came alive in May with a round of price increases, a surge in activity, favorable statistical data and general bullish sentiment.

Asarco, a producer and custom smelter, began the month by raising its price 1c to 30c a lb delivered. Producers and smelters followed. The new quote lasted until May 16 when The Anconda Co. raised another 1c to 31c. Producers followed up. In the interim, smelters withdrew official prices. They sold mainly at the monthly average, but moved substantial amounts at above 32c during the month. The dual pricing policy continued through the end of the month.

Real and potential factors combined late in April to bring firming pressure on the market. Perhaps the most important was the authentic increase in buying in the U.S. market. Sales abroad maintained a healthy pace.

The LME and N.Y. Comex crept up steadily during the month with the former hitting £248¾ (31.1c) on May 24 and the latter 32.58c on the same day. By the end of the month London had slipped to £240 (30c) in what was widely called a technical adjustment. N.Y. observers were looking for the quotation to move back up slowly. Comex dipped in sympathy with London.

Statistics for April were bullish. World refined stocks dropped 29,000 tons, and world deliveries of 325,000 tons were second only to September 1960's 328,660. Cutback output of 293,326 tons was the lowest since July 1960. Copper fabricator sales soared to the highest point since September 1959. Although shipments were better, receipts exceeded them and pushed fabricator stocks up about 5,000 tons.

Of vital importance to smelters was the squeeze on scrap. Ingot makers, deprived of brass raw material by inflated Japanese bids, joined smelters and European buyers in competition for No. 2 copper scrap. The quoted price reached 28¼c with premiums paid regularly. The high price for scrap pinched the smelter's working margin and pushed his effective price for 90-day production into the neighborhood of 33c.

A Chilean dock strike and an illegal walkout at the Kennecott El Teniente property, also in Chile, were settled inside of a week. The market is looking ahead to the end of June when labor contracts for most of Kennecott's U.S. operations run out.

Aluminum began giving indications that it was following copper out of the recession. March U.S. Bureau of Mines figures showed a gain of 19,000 tons in shipments of primary, 6,000 tons above the 1960 monthly average. Stocks dropped for the second straight month, this time by 10,000 tons, from the record 291,000 tons of January.

April production reported by The Aluminum Assn. was 144,637 tons, 70.8% of industry capacity, down from 152,022 and 72.1% in March.

Premiums for special grades of zinc were cut during the month. The lagging automobile industry brought about a slowdown in call for die casting grades, and stocks began building at the plants of producers. Discounts below published premiums were offered. In an effort to correct the situation, Asarco effective May 15 cut its premium for High Grade from 1.35c a lb to .85c and that of Special High Grade from 1.5c to 1c. All sellers followed. St. Joe Lead dropped its Intermediate price from .5c a lb to .2c on May 16, and American Zinc trimmed Brass Special from .25c to .2c.

About a week later complaints of further discounts were heard. An immediate industry scare disappeared when many sellers announced intention of maintaining the new premiums. Market feeling was that sellers would give the current premiums a thorough opportunity to establish themselves before considering further action.

Prime Western sales to galvanizers continued strong, and there was some resurgence in demand by brass makers. The 11½c East St. Louis Price was steady.

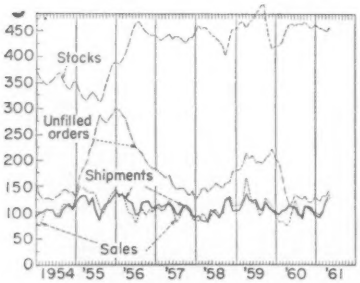
Reports of lead sales to E&MJ in May were the best since January 1960. Some of this activity naturally reflects shipments to be made in June, but statistics are expected to be somewhat improved for May and June after a so-so report for April which saw stocks climb to a two-year high and U.S. shipments decline by 1,000 tons. The 11c price is steady with many convinced it won't go lower.

Lead was returned to the barter list by The Agriculture Dept. Deals were expected to remove about 100,000 tons of surplus lead to the U.S. stockpile with Canada and Australia major contributors.

When early in the month, Ewen Fergusson, chairman of Straits Trading Co., predicted that Free World tin output would not exceed 120,000 tons in 1961, world markets soared. The LME reached £873 on May 17—a mere £7 from the Buffer Stock mandatory-sell level.

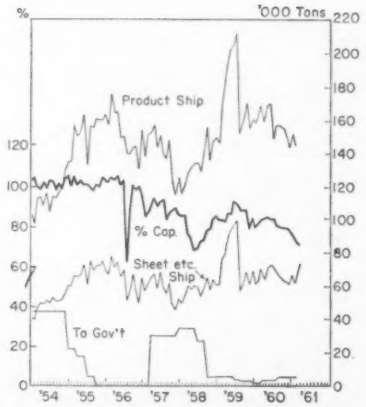
To help curb a runaway **market, the** Canadian government is releasing 3,000 tons of stockpile metal to Canadian consumers. The U.S. is reported ready to sell 4,000 tons of tin, but nothing official has been announced. Some word on this and the general under-supply situation was expected to come out of the ITC meeting in London which ended on May 23. However, the Council was strangely non-committal, and merely announced that it had reviewed the matter—nothing more.

U.S. Copper Fabricator Data



Data in thousands of short tons from U.S. Copper Assn. The sales and shipment series are related only to purchases of refined copper by the fabricators, including copper refined by custom smelters from their intake of scrap and concentrates. All statistics refer to brass mills, wire mills and foundries. All series are for fabricated products except stocks which are of refined copper and copper in process. April is the last month indicated. Sales and shipments series are two months moving averages.

U.S. Aluminum



The left hand scale shows the percentage of capacity. "% cap." (heavy line) indicates the operating rate of U.S. primary plants; capacity is based on data released by aluminum firms and output on Aluminum Assn. figures. "Product ship" refers to U.S. Census data on shipments of aluminum mill products and of aluminum castings — products made from secondary and imported aluminum are included. "Sheet etc. ship" refers to Aluminum Assn. data on sheet, plate and foil. "To Gov't" refers to U.S. primary aluminum shipped to the U.S. Government. Annual figures for 1953-56 are estimated; 1957-59 are public. Monthly allocation of annual amounts is based on information (not specific tonnages) then current on changes in amounts taken by the Government. Data through March, except for shipments to Government and product shipments which are through February.

Average Prices May (E&MJ Quotations)

Cents per lb unless otherwise indicated:

Copper:	
Electro, domestic refinery	29.985
Electrolytic, exports refinery	29.505
Electrolytic, c.i.f. Cont'l ports	30.450
Lead:	
Common, New York	11.000
Common, St. Louis	10.800
Silver:	
Silver, New York, per oz.	91.375
Silver, London, pence per oz.	79.375d
Zinc:	
Prime, Western, East St. Louis	11.500
Prime, Western, delivered (g)	12.000
Tin:	
New York Straits	110.108
Gold, per oz., U.S. price	$35.000
Sterling Exchange	279.396
Quicksilver, per flask	$203.000
Antimony, (E&MJ) (d)	36.250
Antimony, bulk, Laredo	32.500
Antimony, in cases, Laredo	33.000
Antimony for, 99% (h)	28.125
Palladium, troy oz.	$24.000
Platinum, refined, per oz.	$82.000
Cadmium (a)	160.000
Cadmium (b)	170.000
Al, 99½% unalloyed ingot	26.000
export, ingot	23.250
Magnesium, ingot	35.250
Nickel (f)	74.000
Bismuth	$2.250
Cobalt	$1.500

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quick-silver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

Free Gold Market

Global gold transactions showed a 3¾% decline in volume during May. Bar gold and coin prices were somewhat lower in European centers while far Eastern markets listed fractionally higher prices. Soviet gold sales in the past three months amounted to approximately $200 million, which surpasses total sales during all of 1960. Gold futures dealings subsided and averaged about $5,000 daily.

Six months contracts carried interest charges of 4½% p.a. against dollars and 3% p.a. against Swiss francs or DM. One year futures could be obtained at about ½% higher rate. The U.S. gold stock continued to increase rising about $13-million to $17.403-billion. Pick's World Currency Report quotes on "free gold" per fine oz as follows:

	Coins		Bars (12.5 kg)	
	Apr. 30	May 31	Apr. 30	May 31
New York transit	.....	.....	$35.10	$35.10
Manila	$41.25	$41.30	35.90	35.95
Hong Kong	48.35	48.75	39.00	38.75
Bombay	56.60	56.60	53.50	53.25
Beirut	40.75	40.10	35.285	35.23
Paris	40.40	40.10	35.50	35.60
Buenos Aires	41.40	40.65	36.45	36.40

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of May reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛¢; ¼¢ deducted for selling common.

Delivered consumer's plant	30.125 lb
F.o.b. refinery	29.725 lb

Major Metals

U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

May 1961	Electrolytic Copper (a) Domestic	(b) Export	Europe c.i.f. (e)	Lead New York	Lead St. Louis	Zinc (f) Delivered	Zinc East St. Louis	Aluminum Unalloyed Ingot 99%+	Straits Tin New York
1	28.600	28.675	29.620	11.000	10.800	12.000	11.500	26.000	107.625
2	28.900	28.400	29.345	11.000	10.800	12.000	11.500	26.000	107.625
3	29.600	28.800	29.745	11.000	10.800	12.000	11.500	26.000	107.750
4	29.600	28.850	29.795	11.000	10.800	12.000	11.500	26.000	108.750
5	29.600	29.175	30.120	11.000	10.800	12.000	11.500	26.000	109.375
8	29.600	29.175	30.120	11.000	10.800	12.000	11.500	26.000	109.875
9	29.600	29.275	30.220	11.000	10.800	12.000	11.500	26.000	110.250
10	29.600	29.450	30.395	11.000	10.800	12.000	11.500	26.000	110.250
11	29.700	29.800	30.745	11.000	10.800	12.000	11.500	26.000	109.750
12	29.850	29.475	30.420	11.000	10.800	12.000	11.500	26.000	109.750
15	29.625	29.350	30.295	11.000	10.800	12.000	11.500	26.000	110.250
16	29.900	29.700	30.645	11.000	10.800	12.000	11.500	26.000	110.750
17	30.125	29.750	30.695	11.000	10.800	12.000	11.500	26.000	111.250
18	30.350	29.925	30.870	11.000	10.800	12.000	11.500	26.000	111.000
19	30.650	30.025	30.970	11.000	10.800	12.000	11.500	26.000	110.625
22	30.625	Holiday	Holiday	11.000	10.800	12.000	11.500	26.000	110.750
23	30.625	29.900	30.845	11.000	10.800	12.000	11.500	26.000	110.875
24	30.600	30.350	31.295	11.000	10.800	12.000	11.500	26.000	111.000
25	30.625	30.175	31.120	11.000	10.800	12.000	11.500	26.000	111.125
26	30.625	30.025	30.970	11.000	10.800	12.000	11.500	26.000	111.125
29	30.675	29.650	30.595	11.000	10.800	12.000	11.500	26.000	111.375
30	Holiday	29.650	30.595	Holiday					
31	30.600	29.525	30.470	11.000	10.800	12.000	11.500	26.000	111.250
AVERAGES FOR WEEK									
May	29.985	29.505	30.450	11.000	10.800	12.000	11.500	26.000	110.108
AVERAGES FOR MONTH									
May 3	28.860	28.410	29.355	11.000	10.800	12.000	11.500	26.000	107.750
10	29.600	29.185	30.130	11.000	10.800	12.000	11.500	26.000	109.700
17	29.840	29.615	30.560	11.000	10.800	12.000	11.500	26.000	110.350
24	30.570	30.050	30.995	11.000	10.800	12.000	11.500	26.000	110.850
31	30.631	29.805	30.750	11.000	10.800	12.000	11.500	26.000	111.219
CALENDAR WEEK AVERAGES									
May 5	29.260	28.780	29.725	11.000	10.800	12.000	11.500	26.000	108.225
12	29.670	29.435	30.380	11.000	10.800	12.000	11.500	26.000	109.975
19	30.130	29.750	30.695	11.000	10.800	12.000	11.500	26.000	110.775
26	30.620	30.113	31.058	11.000	10.800	12.000	11.500	26.000	110.975

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U.S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deducted.

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver .999 fine as made to Handy & Harman for nearby delivery at New York by regular suppliers in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price at which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis .999 fine.

(d) U. S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

(e) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance. Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U.S. lead is corroding grade).

Silver, Gold and Sterling

DAILY AND AVERAGE PRICES

May 1961	Silver (c) New York	Silver London	Sterling Exchange	Gold (d) London
1	91.375	79.375d.	279.5620	250s. 10½d.
2	91.375	79.375d.	279.5060	250s. 10¾d.
3	91.375	79.375d.	279.5840	250s. 10¾d.
4	91.375	79.375d.	279.6580	250s. 10¾d.
5	91.375	79.375d.	279.5975	250s. 9¾d.
8	91.375	79.375d.	279.5920	250s. 9¾d.
9	91.375	79.375d.	279.5620	250s. 9½d.
10	91.375	79.375d.	279.5480	250s. 10d.
11	91.375	79.375d.	279.5700	250s. 10d.
12	91.375	79.375d.	279.4720	250s. 10d.
15	91.375	79.375d.	279.3780	250s. 10½d.
16	91.375	79.375d.	279.3740	251s. ¼d.
17	91.375	79.375d.	279.2900	251s. 0d.
18	91.375	79.375d.	279.3300	251s. 1d.
19	91.375	79.375d.	279.2060	251s. ¾d.
22	91.375	Holiday	279.2420	Holiday
23	91.375	79.375d.	279.2680	251s. 1d.
24	91.375	79.375d.	279.3220	251s. 0d.
25	91.375	79.375d.	279.2533	251s. ¾d.
26	91.375	79.375d.	279.1600	251s. 1½d.
29	91.375	79.375d.	279.0750	251s. 1¾d.
30	Holiday	79.375d.	Holiday	251s. 3d.
31	91.375	79.375d.	279.1540	251s. 3d.
AVERAGES FOR MONTH				
May	91.375	79.375d.	279.396	—
AVERAGES FOR WEEK				
3	91.375	—	279.598	—
10	91.375	—	279.592	—
17	91.375	—	279.417	—
24	91.375	—	279.274	—
31	91.375	—	279.161	—

Calendar Week Averages: New York Silver: May 5, 91.375; May 12, 91.375; May 19, 91.375; May 26, 91.375.

MARKETS *(Continued)*

London Metal Exchange Quotations

May 1961	Copper Cash Bid	Copper Cash Asked	Copper 3 Mon. Bid	Copper 3 Mon. Asked	Lead Current Month Bid	Lead Current Month Asked	Lead 3 Mon. Bid	Lead 3 Mon. Asked	Zinc Current Month Bid	Zinc Current Month Asked	Zinc 3 Mon. Bid	Zinc 3 Mon. Asked	Tin Cash Bid	Tin Cash Asked	Tin 3 Mon. Bid	Tin 3 Mon. Asked
1	234½	234½	235¾	236	67½	67¾	68¾	68¾	83½	83¾	83¾	83¾	843	843½	849	849½
2	235	235¼	236½	236¾	67¼	67½	68½	68⅝	83½	83⅝	83½	83⅝	841	841½	847½	848
3	235¾	236	237	237¼	66½	66¾	68	68⅛	83¼	83¼	83¼	83¼	841½	842	848	849
4	238½	238¾	239¾	240	67½	67⅝	68⅝	68¾	83¼	83⅜	83⅜	83½	850½	851	854½	855
5	239¼	239¾	240½	240¾	67½	67⅝	68¾	68⅞	83⅜	83½	83⅜	83½	856	857	859	860
8	241¼	241½	242	242¾	67¾	67⅞	69	69⅛	83	83⅛	83	83⅛	860	861	861	861½
9	243¼	243½	243¾	244	68¼	68⅜	69¼	69⅜	83¼	83⅜	83¼	83⅜	861½	862	865½	866
10	241¾	242	242¾	243	67⅜	67¾	68⅞	69	82⅞	83⅛	83⅛	83¼	861½	862	865½	866
11	243¼	243½	243¾	244	67¾	67⅞	68⅝	68½	82¾	82⅞	83	83⅛	857½	858	863	863½
12	242	242¼	242¾	243	66¾	66⅞	68	68⅛	81⅞	82	82¼	82⅜	859½	860	863½	864
15	243¼	243½	244¼	244½	66⅞	67	68¼	68¼	81⅝	81½	81⅞	82	863½	864	867½	868
16	244½	244¾	245½	245¾	66⅞	67	68	68¼	80⅞	81	81½	81⅝	869	869½	873	873½
17	245½	245¾	246¼	246½	66⅜	67⅛	68¼	68½	81½	81⅝	82	82¼	873	873½	876	876½
18	244¼	244¾	245¼	245¾	66⅝	66¾	67¾	68	81¾	81⅞	82¼	82⅜	868	869	872	872½
19	244½	244¾	245½	245¾	66½	66⅝	67¾	67⅞	81¾	81⅞	82⅛	82¼	867½	868	871	871½
22	Holiday															
23	248	248¼	248½	248¾	66½	66⅝	67¾	67⅞	82¼	82⅜	82¾	82⅞	869½	870	872½	873½
24	248¾	249	249½	249¾	65⅝	65¾	66⅞	67	82¼	82⅜	82¾	82⅞	870	871	874½	875
25	247	247½	248¼	248½	65⅝	65⅞	67	67⅛	82¼	82⅜	82¾	82⅞	869	870	874½	875
26	243¼	243½	244¾	245	65	65¼	66¼	66½	81⅞	81½	82⅛	82¼	868	869	873½	874½
29	242¾	243	244¼	244½	64⅜	64½	65⅝	65⅞	81½	81¾	82	82¼	870½	871	874½	875
30	243¾	244	245½	245¾	65	65¼	66¾	66⅝	81⅞	82⅛	82⅝	82¾	871	873	877½	878
31	240	240¼	242¼	242¾	64¾	64⅞	66	66¼	81¾	82	82¼	82½	869½	870	875	875½
Av'g's	£242.409		£243.517		£66.645		£67.881		£82.395		£82.733		£862.193		£866.568	

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.0%, zinc 98% and tin min. 99.7%.

Miscellaneous Metals, Ores, Minerals

Quotation recover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

MISCELLANEOUS METALS

May 31, 1961

Aluminum ingot, 99.9% lb		28c
Antimony, spot, lb. less than carload, in cases		36.250c
In bulk, carload lots, f.o.b. Laredo		32.5c
Imported, 10 ton min. (p), 99% Duty not paid	28c —	28.25c
Bismuth, ton lots, lb		$2.25
Cadmium, ton lots delivered, lb		$1.60
small lots		$1.70
Calcium, lb, ton lots, 98%, cast		$2.05
Chromium, 99.8% grade, lb, contract delivered	$1.15 —	$1.19
Cobalt, 97 to 99%, per lb effective 3-1-60		$1.50
Germanium, per gram, 10,000 gram lots	(d)28.15c—(c)(d)	29.95c
Indium, troy oz	$1.35 —	$2.25
Lithium, lb, 98%	$9.00 —	$11.00
Nickel, cathodes, lb (a)		74c
Other sales, regular sellers		74c
Sales by dealers, etc.		74c
Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16		35.25c
Palladium, troy oz	$24 —	$26
Platinum, troy oz	$80 —	$85
Quicksilver, flask of 76 lb, 25 flasks or more	$203 —	$206
Selenium, 99 plus %, lb—(Feb. 19, 1958)	$6.50 —	$7.50
Silicon, minimum 98%, carloads, lb		19c
Semi Conductor grade, lb., lump		$360
Tellurium, lb		$5.25
Thallium, 100 lb or more		$7.50
Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b)	$1.50 —	$1.60

(a) Effective Dec. 6, 1956; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

METALLIC ORES

Beryllium ore, imported, 10% BeO, (b) stu; spot	$32 —	$33
term contracts	$34 —	$34.50
Chrome ore per long ton, f.o.b. cars Atlantic ports, dry:		
44% Cr_2O_3 no ratio	(a)$19.75 —	$20.50
48% Cr_2O_3 3 to 1 ratio	$35¾ —	$38
Iron ore, Lake Superior, Lower Lake ports, lt		
Old Range bessemer		$11.85(e)
Mesabi bessemer		$11.60(e)
Mesabi non bessemer		$11.45(e)
Lead (Galena), 80%, Joplin, Mo., ton		$125.16
Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.		
Molybdenum ore, 90%, per lb of Mo f.o.b. mines		$1.40
Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio	$1.18 —	$1.25
Tungsten ore, per stu of WO_3:		
Foreign 65%, c.i.f. U. S. ports, duty extra	$15.25 —	$15.75
U. S. scheelite, f.o.b. mill	$22 —	$24
Vanadium ore, per lb of contained V_2O_5 f.o.b. mines		31c
Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton.		$68

(a) Nominal. (b) c.i.f. U. S. ports. (e) Effective 1958 shipping season.

METALLIC COMPOUNDS

Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks		4c
Cobalt, oxide, 72½% to 73½%, per lb, effective Mar. 1, 1960	$1.15 —	$1.18
Copper sulphate, 100 lb, effective 5-17-61		$12.50
Germanium dioxide, gm		16¾c
Molybdic trioxide, technical, per lb of Mo	$1.59 —	$1.60
Imported, including 37c duty	$1.75 —	$2.05

ALLOYS

Ferrochrome 65 to 70%, per lb of Cr, (4-9% C)		28¾c
Ferromanganese, 74 to 76%, per lb shipping point		11c
Ferromolybdenum, 58 to 64% Mo. lb of Mo contained	$1.63 —	$1.95
Ferrosilicon, 50% per lb of Si f.o.b. shipping point		14.60c
Ferrotungsten, 72 to 82%, lb of W contained		$2.25
Ferrovanadium, per lb of V delivered	$3.20 —	$3.40
Silicomanganese, max., 1½% C, lb contracts		11.6c
Spiegeleisen, per lt, 19-21% grade	$98 —	$101

NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:			
Crude No. 1	$1,400–$1,725	Paper stock	$120–$142
Crude No. 2	$750–$1,155	Waste	$75– $86
Spinning fibers	$370– $600	Shorts	$40– $75
Shingle fibers	$180– $220		
Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):			
Crude No. 1	$1,522	Spinning fibers	$470–$787
Asbestos, Vermont, f.o.b. Morrisville:		Shingle fibers	$142–$325
Spinning fibers	$353– $408	Waste, stucco or plaster	$86
Shingle stock	$181– $218		
Paper stock	$120– $142	Refuse or shorts	$41– $75
Barytes, f.o.b. cars:			
Georgia, crude, per ton			$18
Missouri, 94%, $BaSo_4$, per st	$16 —		$18
Crude oil well grade, min. 4.3 sp gr, st (a)			$18
Imported, c.i.f. Gulf Ports, st	$12½ —		$14
Bauxite, st, f.o.b. point of shipment:			
Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% Al_2O_3, 6% SiO_3, 1.25% Fe, 1-1-60			$7.25
Feldspar, bulk ton; f.o.b. plants:			
Potash or soda feldspar, 200 mesh, ceramic grade	$17 —		$20.50
Glass feldspar, white, 20 mesh			$9
Fluorspar, f.o.b. mines, bulk, 72½% effective, ton	$37 —		$41
60% effective CaF_2	$33 —		$36
Acid 97% concentrate, bulk, ton f.o.b. Ill	$45 —		$50
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00 —		$14.00
Magnesite, per ton dead-burned, bulk, f.o.b. Washington			$46

Mica—Domestic, f.o.b. mines, Punch 7c-12c per lb according to size and quality. Sheet clear 1½x2 in, 70c-$1.10; 2x2 in, $1.10 to $1.60; 2x3 in; $1.60-$2.10; 3x3 in, $1.80-$2.30; 3x4 in, $2.00-$2.60; 3x5 in, $2.60-$3.00, 4x6 in, $2.75-$4.00; 6x8 in, $4.00-$8.00. Wet ground, very fine, $140-$155 per ton, Bulk sales, dry ground; $30-55 per ton. Scrap $20-$30.

Ocher, Georgia, ton in sacks	$26.50 —	$32.00
Sulphur, Mexican, for use in Mexico, metric ton, f.o.b. mines, depending on location	$21 —	$23
For export f.o.b. vessel, depending on grade	$22.50 —	$23.50

Actual prices received by U. S. producers approximate the Mexican export prices.

Talc, f.o.b. works, ton:		
New York, purified	$18.00 —	$20.00
Vermont, extra fine		$12.50
Tripoli, Missouri, ton:		
40-mesh, cream colored		$50.00

(a) Some restricted sales at $11.50; (b) Corrected; (c) Nominal.

IRON AND STEEL

Pig iron, gross ton, basic, Valley furnaces		$66.00
Steel, f.o.b. Pittsburgh, billets, net ton		$80.00
Structural shapes, Pa., Ala., etc., 100 lb	$5.30 —	$5.50

TRAYLOR-MADE

TRAYLOR ENGINEERING & MANUFACTURING

DIVISION OF FULLER COMPANY

1560 MILL STREET, ALLENTOWN, PA.

BULLETIN TGB-3

TRAYLOR BULLDOG GYRATORY CRUSHER

Type TC is the most advanced design of large capacity gyratory crushers. Built in six sizes with capacities ranging from 245 tons of a 2″ product to 4100 tons of an 11″ product, these gyratories feature Traylor original non-choking, self-tightening bell heads and curved concaves. Massive construction provides for shock absorption and, at the same time, all parts are readily accessible for maintenance. The Traylor patented dust seal provides a practical and efficient device for excluding dirt from the lubrication chamber. All of the features you want in your crushing machinery can be found in the Traylor TC Gyratory Crusher.

TRAYLOR . . . a name that means the very best in mining machinery, manufactures . . .

Gyratory Crushers

Jaw Crushers

Rotary Kilns,

Coolers, Dryers

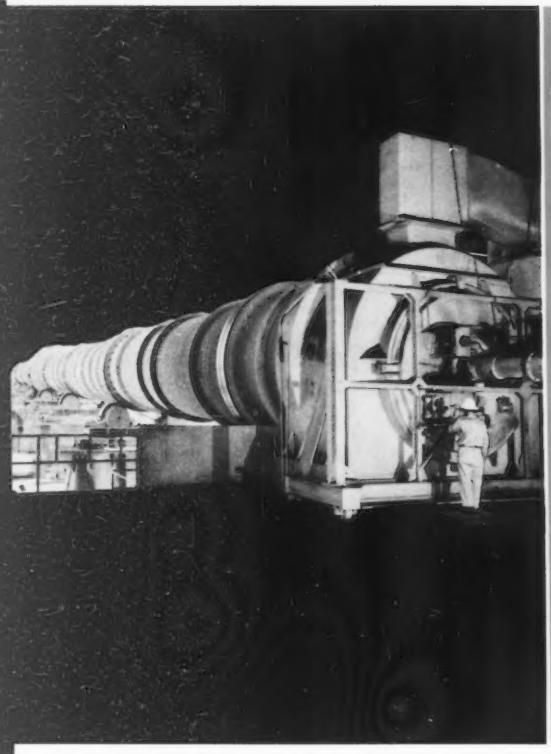
Grinding Mills

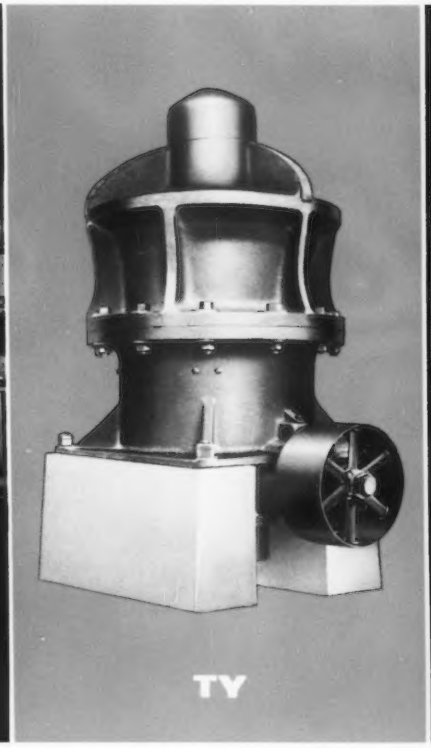
Feeders

Copper Convertors, Casting Machines

ROTARY CRUSHING

offer operating efficiency





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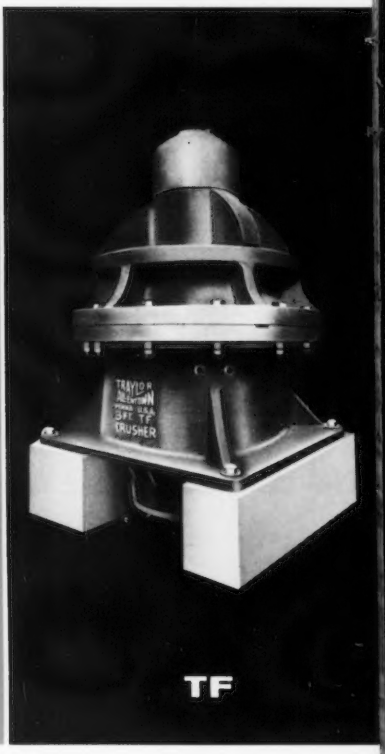


TF

ROTARY kilns

Hundreds of rotary kilns have been engineered, fabricated and delivered by Traylor Engineering. High standards of craftsmanship have produced the finest thermo-processing equipment available for calcining, roasting, chloridizing, volatilizing, sintering and nodulizing. The shells of Traylor-Kilns are made of heavy steel plate, automatically welded together, and Traylor engineers pioneered in the perfection of the easy aligning single roller supports. The full solid floating type of tire is mounted securely in place on the shell, and the main gears and pinions, made of steel, are reversible. Traylor Kilns have been built to 12′-0″ diameter, 450′-0″ long. For details on Traylor Rotary Kilns, Coolers, Dryers and Slakers, write for Bulletin No. 1115.

SECONDARY crushers

Traylor makes two types of reduction crushers: the TY in six sizes from 1′-3″ to 5′-6″ with feed openings from 3″ to 22″, and the TF Fine Reduction Crusher for operators whose needs demand economic production of $\frac{5}{16}$″ to $1\frac{1}{4}$″ material in large capacity. Both types require less head room because of their compact, simplified design and Traylor original curved concaves and self-tightening bell heads are used in the TY and TF Crushers. The design, construction and operational features embodied in these reduction crushers are the direct result of Traylor's long and diversified experience and leadership in the ore and stone crushing field. **Bulletin Nos. 8112, 1126 and 127.**

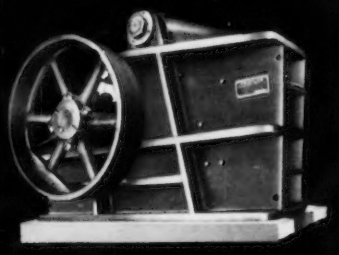
NEW YORK: 380 Madison Avenue, New York 17, N. Y. OXford 7-2525

CHICAGO: 3909 Field Bldg., 135 S. LaSalle St., Chicago, Ill. DEarborn 2-3952

SAN FRANCISCO: 612 Chancery Bldg., 564 Market St., San Fransisco 4, Calif. YUkon 1-0677

KILNS AND MACHINERY

and long-life economy



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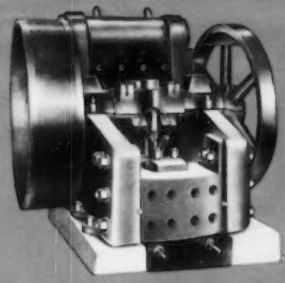

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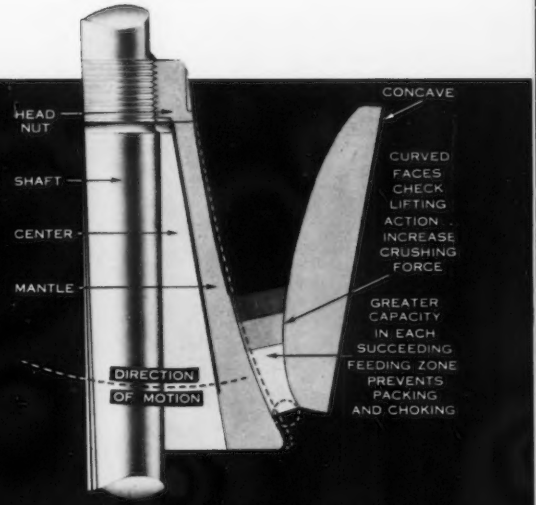


CURVED CRUSHING SURFACES, an original Traylor development, are shaped so that the faces are opposed to the direction of motion. Power requirements are reduced, even at finer settings, because more of the power applied is used as a direct crushing force.

By increasing the capacity of each succeeding feeding zone in the crushing chamber, choking and packing are practically eliminated.

JAW crushers

Traylor Jaw Crushers are built in four types with 18 different size feed openings. Capacities range from four tons of 3/8" material to 1,000 tons of 11" material per hour. The four types of Traylor Jaw Crushers are One Piece Cast Steel, One Piece Welded Steel Plate, Sectionalized Cast Steel and Steel Plates, and Meehanite Iron, and all four are precision built to perform their rugged task efficiently. As the result of more than a half-century's experience in building crushers, Traylor has developed one of the most advanced groups of jaw crushers. **Bulletin Nos. 104 and 125.**

Traylor's patented swing jaw suspension and originally developed curved jaw plates account for greater capacity at finer settings and longer life of jaw plates. Traylor's curved jaw plates will outwear ordinary plates as much as 3 to 1. All frames are reinforced at critical points to provide strength without excessive weight. For more information on Traylor-Made Jaw Crushers, state your requirements and a bulletin will be forwarded to you immediately.

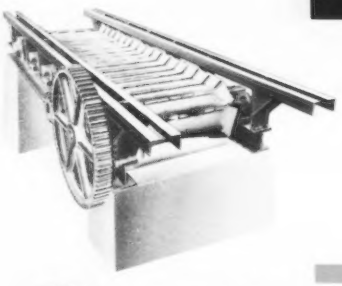
FOREIGN SALES AGENCIES: Lima, Rio de Janeiro, Buenos Aires, Santiago, Antofagasta, Oruro, La Paz, Montevideo, S. A.; Madrid, Spain; Oslo, Norway; San Juan, Puerto Rico; Manila, P. I.; London, England.

AUSTRALIAN MANUFACTURER: Jaques Bros., Richmond E-1, Victoria, Australia

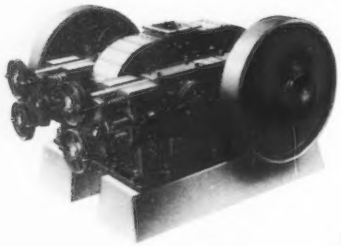
CANADIAN MANUFACTURER: Canadian Vickers, Ltd., P. O. Box 550, Place D'Armes Station, Montreal, P. Q., Canada

other fine TRAYLOR-MADE *products*

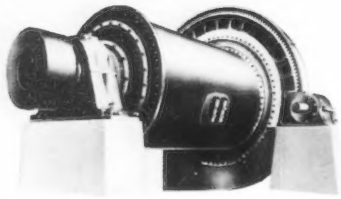
in use by the mining industries throughout the world



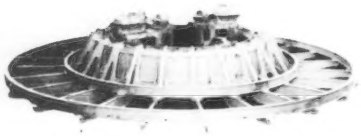
TRAYLOR FEEDERS are made in four types specially designed for application in the several steps of crushing, grinding, drying or calcining. These four are the Sheridan Grizzley Feeder, the Apron or Pan Feeder, the Table Feeder and the Slurry Feeder. Grizzley Feeders are made in sizes from 3'-0" x 6'-0" to 10'-0" x 20'-0" and Apron Feeders are adapted to the size and kind of material to be handled. Feeders are made in widths of 30" to 84" in any length required. All Traylor Feeders are adapted to the size and kind of material to be handled and are easily adjusted to vary their rate of delivery of material. For more on Traylor Feeders write for Bulletin No. 2114.



TRAYLOR CRUSHING ROLLS are built in three types. The Four Tension Rod type is capable of delivering large capacities and standing up under the most severe continuous service. Type AA and A Rolls are designed for lighter service. The range in size of the three rolls is from 18" dia. x 10" face to 78" dia. x 24" face with tension springs to develop pressures up to 40,000 lbs. per lineal inch of roll face. Write for Bulletin No. 6637.



TRAYLOR GRINDING MILLS are available in Ball, Rod, Compartment and Pebble Mills. Made in two types, overflow and diaphragm discharge, Traylor Ball Mills are built for either wet or dry grinding. They feature shell liners of manganese, high carbon, or chrome moly steel or nickel iron in plain, wave, cascade, lifter or rolled types with shells of welded steel construction. Trunions are cast integrally with the heads. Main bearings are made of Meehanite metal with larger sizes fitted with a high-pressure Alemite pump. Steel driving gears are precision-cut on Traylor's Maag gear generator. For full details on Traylor Grinding Mills write for Bulletin No. 3103.



TRAYLOR CASTING MACHINES are built in two types: Circular and Straight Line. The heavily proportioned Circular Casting Machine is driven by two motors through separate gear trains, but with a single control. It is designed to run in either direction. The track is conical, and the turn-table supporting the mold platform runs on flanged conical rollers. Traylor Casting Machines have been built in sizes up to 40'-0" and can be designed for anode, cathode, wire bar or pigs. Write for complete information.

TRAYLOR-MADE

TRAYLOR ENGINEERING & MANUFACTURING

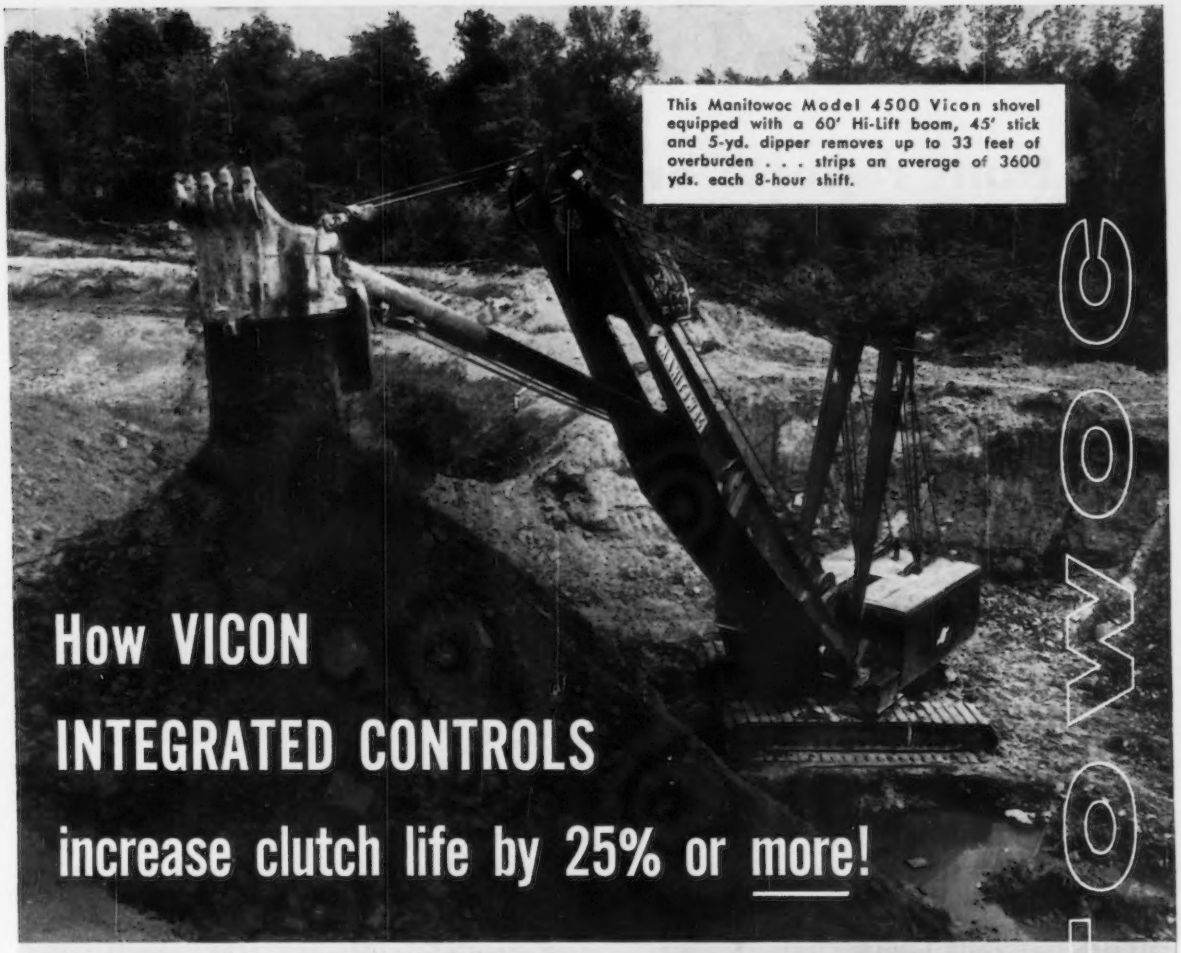
DIVISION OF FULLER COMPANY

1560 MILL STREET, ALLENTOWN, PA.

SALES OFFICES: NEW YORK • CHICAGO • SAN FRANCISCO

CANADIAN MFR.: CANADIAN VICKERS, LTD., MONTREAL, P. Q.

BULLETIN TGB-3—3/61—32.5M PRINTED IN U.S.



This Manitowoc Model 4500 Vicon shovel equipped with a 60' Hi-Lift boom, 45' stick and 5-yd. dipper removes up to 33 feet of overburden . . . strips an average of 3600 yds. each 8-hour shift.

How VICON INTEGRATED CONTROLS increase clutch life by 25% or more!

On-the-job reports confirm that wherever the revolutionary Manitowoc 4500 VICON has gone to work, master mechanics say drum and swing clutch life is appreciably longer than on other excavators in the pits. A typical comment: "In the year that our Manitowoc 4500 VICON has been in operation, we've replaced only one clutch facing. In our other shovels, where clutches are *not* engaged before accelerating the engine, wear on clutch facings is at least 25% greater." The reason: INTEGRATED CONTROLS, one of several pace-setting developments incorporated into VICON design.

VICON operating levers are combination clutch controls and engine throttles. The clutches respond to a lower range of control pressures than do the throttles, so they are always engaged before engine speed is increased. With slippage therefore kept to a minimum, there's far less wear of friction linings, far less heat. Clutches run cool, last longer.

Here are more outstanding advantages of the remarkable Manitowoc 4500 VICON. INTERLOCKED DRUMS give you higher cycle speeds and pinpoint bucket control for increased dragline production. With DUAL INDEPENDENT ENGINES, the operator can perform several functions simultaneously with full power instantly available for each . . . has a choice of speeds at his fingertips to match cycle phases to job conditions.

The 4500 VICON is offered as a 6-yd. shovel or 7-yd. dragline. See your Manitowoc distributor for complete details, or write for the fully illustrated 16-page VICON catalog (No. 33-60).

SHOVELS 1¼ to 6 YDS.

Manitowoc

DRAGLINES 1¼ to 7 YDS.

MANITOWOC ENGINEERING CORP.
(A subsidiary of The Manitowoc Company, Inc.)
MANITOWOC, WISCONSIN

MANITOWOC

Du Pont reports on

a new type of conveyor belt carcass

that sets new standards of performance

Made with load-bearing components of DACRON® fiber, it resists deterioration better, carries more, cuts handling costs

Today, a new type of conveyor belting offers you cost-saving performance on the toughest jobs in industry. The reason is a fabric carcass made with strong reinforcements of "Dacron"* polyester fiber running the length of the belt.

Superior resistance to deterioration—"Dacron" is not affected by rot and mildew, so these belts do not have problems with moisture in cover cuts, or when fabric is exposed in the splice area. "Dacron" also withstands belt-fastener rust and most chemicals to assure long service under tough, wet or dry operating conditions.

Improved durability—Impact resistance is excellent. The high strength of "Dacron" teams up with the strength and elasticity of nylon, the cross fiber, to sustain shock loads. "Dacron" resists stretch. This means lower growth of the belt in service—fewer take-ups.

Better flexing and troughing—Because of this high-strength carcass made with "Dacron", these belts can be thinner, permitting the use of smaller-diameter pulleys. They are more flexible, train better on idler rolls—resulting in less belt wander and edge wear. These belts have a better resistance to flex failure—an important long-life feature.

Troughing up to 45° is possible, compared to the usual 20°. This means belts can be narrower and lighter—and still carry larger loads. The result is reduced handling costs right down the line!

More for your belt dollar—It all adds up to superior performance and the economy of long service with fewer belt replacements, less down-time, lower maintenance costs. Make sure you ask about conveyor belts made with "Dacron" polyester fiber next time you order—get the most for your belt dollar!

E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Dept., 191 South Main St., Akron 8, Ohio.

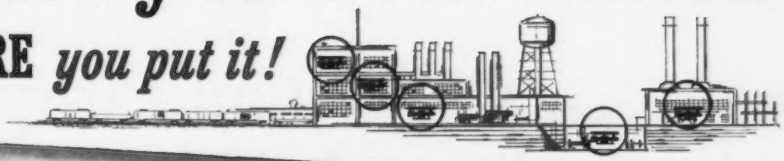
*Du Pont's registered trademark for its polyester fiber.

DU PONT
REG. U.S. PAT. OFF.
Better Things for Better Living
. . . through Chemistry

DACRON® *polyester*
the conveyor belt fiber

Conspicuous by its Performance

...no matter WHERE you put it!



Clark Model CMB-2 Balanced/Opposed Air Compressor rated at 400 bhp. Models available from 75 to 8000 bhp.

CLARK
Balanced/Opposed
AIR COMPRESSOR

Air Power—100 lb. Variety—The kind that is economical, dependable . . . That's what you get with a compact Clark Balanced/Opposed Air compressor. You may hide it in the basement or the boiler room, but this smooth running veteran will always be conspicuous by its performance.

Efficiency at All Key Points—Compressor cylinders utilize large, streamlined air passages and optimum number of valves to minimize pressure drop, turbulence and valve losses. The heavy duty *Simplaire* valve has only one moving part on the low pressure suction side. Its webbed disc valve ring is opposed by minimum spring force, operates with less total differential pressure than any other compressor valve design. The Clark intercooler is carefully engineered for highest possible heat transfer rates. Double wall construction provides a large surge chamber to minimize pressure drop and assure maximum delivery of air.

A Real Space Saver—Squeeze it into "impossible" places . . . install large amounts of horsepower in limited areas. Compact Clark design with overhung integrally supported rotor makes the most of available space, eliminates bulky extension shafts with outboard bearings and flywheel.

Perfect Running Balance—Clark Balanced/Opposed design cancels out primary and secondary unbalanced forces. Units run smooth and quiet, thereby easing wear on moving parts. Foundations need only be large enough to support the physical weight of the compressor. You can locate a Clark machine anywhere . . . with confidence.

Low, Low Maintenance—Internal components are easy to get at, easy to service. Clark *Simplaire* valves are ultra simple in design, can be readily installed, or disassembled and cleaned. Valve bodies and housings of like size are completely interchangeable for suction or discharge, offer no alignment problems.

Put Greater Efficiency into every compressor dollar you spend. Contact your nearest Clark representative for full details, or write for Bulletin 185.

CLARK
ENGINES · COMPRESSORS
GAS TURBINES

DRESSER INDUSTRIES INC.
OIL · GAS · CHEMICAL
ELECTRONIC · INDUSTRIAL

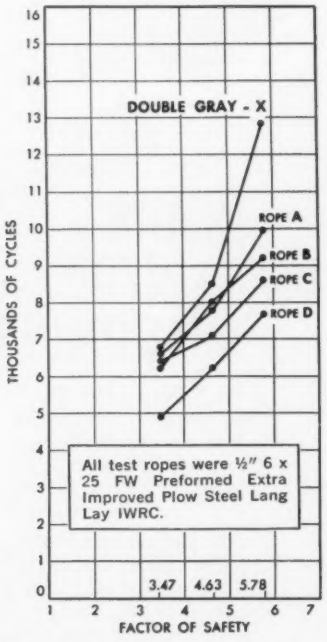
CLARK BROS. CO., OLEAN, N.Y.

CF&I Steel Products... a tradition in the mining industry

Experienced, cost-conscious mining men usually insist on long-lasting, top performing supplies, rather than looking for "bargains." They know that initial cost is frequently the least important part of their investment. That's why so many mining engineers now turn to CF&I for dependable steel products—products like the ones shown on these pages.

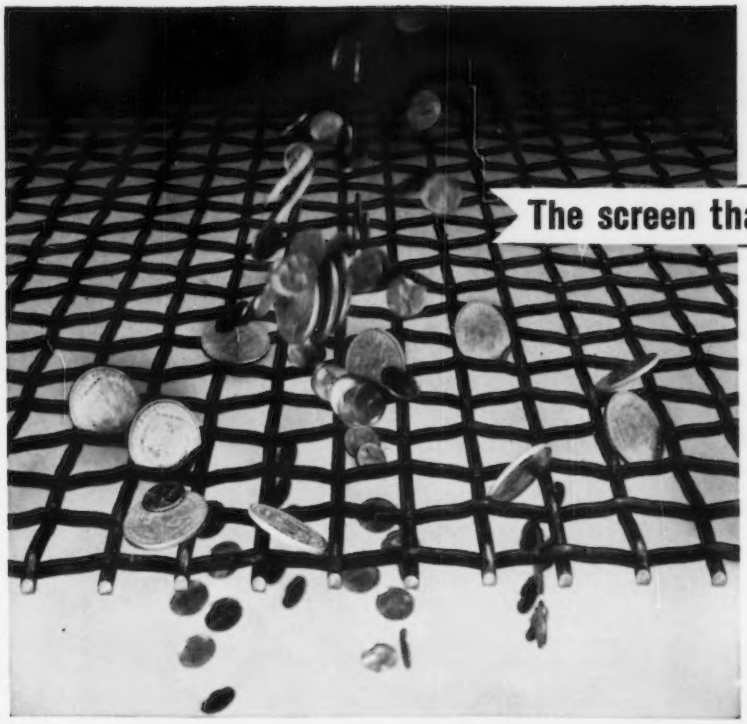
These truly economical "mining tools" are made here in the U.S.A. to above-industry standards. Each has the maximum degree of quality built into it, and is backed by the entire resources of CF&I—your guarantee of real value.

Get the complete money-saving story on CF&I Steel Products for Mining from any CF&I sales-engineer. He'll be glad to sit down with you and review your requirements.



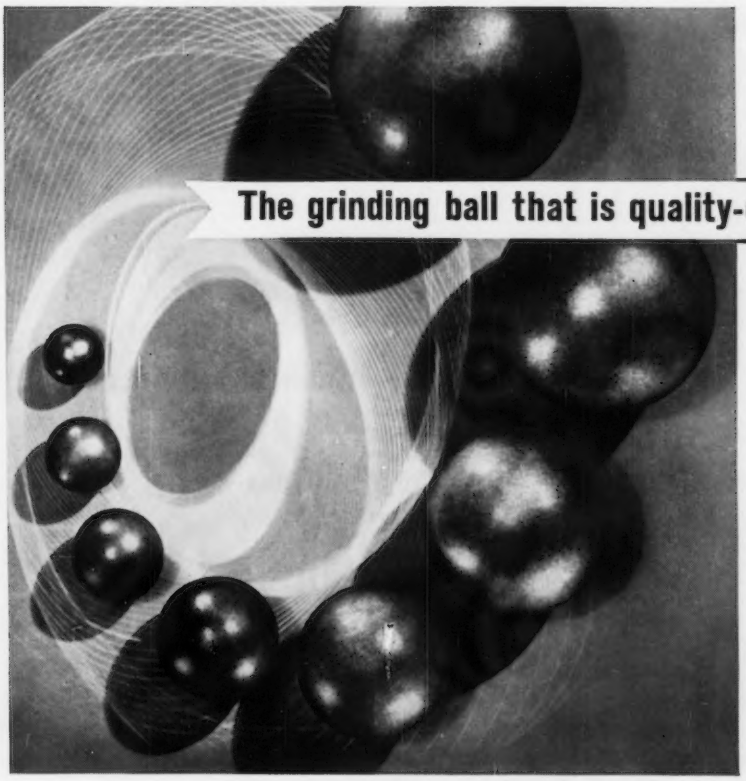
CF&I-Wickwire's new wire rope—Double Gray®-X—lasts longer than other wire ropes. In an extended series of tests at CF&I's Palmer Plant, five competitive high strength wire ropes—all made by major manufacturers—were tested to destruction on a 25,000-lb. fatigue-testing machine. Double Gray-X lasted longer than the other four ropes at all three safety factors used—45%* longer at the highest and most commonly-used safety factor. Because it lasts longer on even the toughest jobs, Double Gray-X lowers your wire rope investment and drastically reduces costly equipment downtime.

***Percentage above average of all other wire ropes tested at safety factor of 5.78.**



The screen that never passes the buck

When you use CF&I Space Screens, you'll find your sizing costs are reduced from "dollars" to "pennies." Made from a variety of steel grades (to meet different sizing conditions), CF&I Space Screens offer maximum resistance to the most punishing abrasion and vibration. This cuts your screen repair and replacement costs, reduces equipment downtime and lowers cost-per-ton of material screened. CF&I Space Screens are made in a wide range of open areas, weaves and crimps, and hooking and edge preparations.



The grinding ball that is quality-controlled all the way

From mine to finished product, CF&I carefully controls every stage of grinding ball manufacture. The result: forged alloy and carbon steel balls with outstanding hardness (resistance to wear), toughness (resistance to impact splitting), uniform roundness and density. This assures optimum grinding plus maximum wearability. CF&I carbon steel balls are available in diameters from ¾" to 5"; alloy balls from 1½" to 4". CF&I also manufactures a complete line of Grinding Rods, Rock Bolts, Cutting Edges and Mine Rails, including accessories.

THE COLORADO FUEL AND IRON CORPORATION
Denver • Oakland • New York
Sales Offices in Key Cities 6285

CF&I STEEL MADE IN U.S.A.

FALK
...a good name in industry

QUALITY GEAR DRIVES and FLEXIBLE SHAFT COUPLINGS

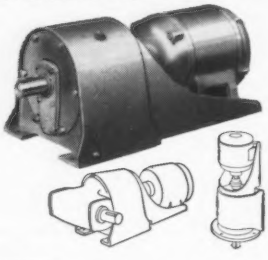
THE FALK CORPORATION, MILWAUKEE 1, WIS. *Representatives and Distributors in many principal cities.*

● The helical and spiral bevel gears in Falk gear drives assure maximum mechanical efficiency attainable—98½% per gear mesh under full load.

ALL-MOTOR MOTOREDUCERS *up to 125 hp.*

All-steel units for use with any NEMA foot-mounted motors within rated capacities of the gear drives. Standard output speeds from 1 to 780 rpm (with 1750 rpm motors); as low as .032 rpm in semi-standard designs. Also Integral units, from 1 to 40 hp.

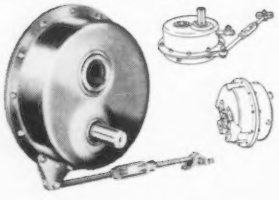
Ask for Bulletin 3100.



SHAFT MOUNTED DRIVES *up to 125 hp.*

All-steel units, horizontal or vertical. Output speeds between 420 and 5 rpm. Maximum torque rating at low speed shaft: 100,000 lb-in. Consult Factory for higher capacities and for flange mounted drives.

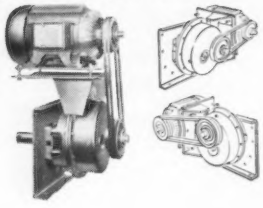
Ask for Bulletin 7100.



SCREW CONVEYOR DRIVES *up to 40 hp.*

Bolt to any standard trough end. Output speeds from 420 to 5 rpm. Max. torque rating at low speed shaft: 44,000 lb-in. Drive includes removable drive shaft and seal housing with choice of seals. Trough end and Motor Mount optional.

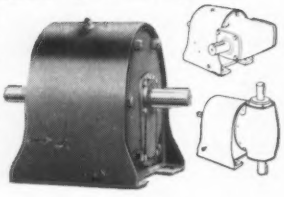
Ask for Bulletin 7106.



SMALL SPEED REDUCERS *up to 350 hp.*

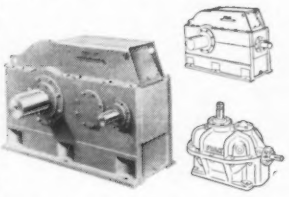
Concentric Shaft reducers with ratios from 1.49:1 to 970:1. Maximum torque at low speed shaft: 94,000 lb-in. **Right Angle** ratios from 5:1 to 1460:1. Maximum torque at low speed shaft: 73,000 lb-in.

Ask for Bulletin 1105.



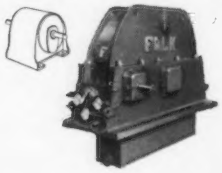
LARGE SPEED REDUCERS *up to 5800 hp.*

Parallel Shaft up to 5800 hp. Ratio range: from 2:1 to 292:1. Maximum catalog torque at low speed shaft: 1,570,000 lb-in. Bulletin 1100. **Right Angle Horizontal** up to 1900 hp. Ratio range from 5:1 to 1200:1. Max. catalog torque at low speed shaft: 1,570,000 lb-in. Bulletin 2100. **Right Angle Vertical** up to 760 hp. Ratio range from 6:1 to 430:1. Max. catalog torque at low speed shaft: 714,000 lb-in. Low speed shaft extension up or down. Bulletin 2110.



HIGH SPEED DRIVES . . . *reducers or increasers.*

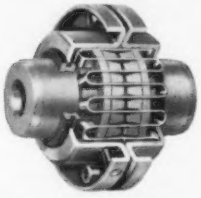
Parallel Shaft drives cataloged up to 5,000 hp or 10,000 rpm. Unit ratios from 1.15:1 to 12:1. Bulletin 5105. **Concentric Shaft** units cataloged up to 225 hp or 4500 rpm. Ratios from 1.5:1 to 25:1. Bulletin 1106.



STEELFLEX COUPLINGS *protect connected machines.*

Hp range: ½ through 72,000 hp at 100 rpm. Exclusive grid-groove design cushions shock loads, accommodates reasonable degrees of shaft misalignment. Basic Type F for 9 out of 10 industrial applications, horizontal or vertical.

Ask for Bulletin 4100.

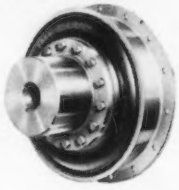


Basic Type F

AIRFLEX COUPLINGS *Designed for mounting shaft-to-shaft, shaft-to-flywheel, or shaft-to-flange.*

15 sizes covering a range from 5 through 2880 hp at 100 rpm. Ideal for applications which have irregular torque characteristics in driving or driven machines (internal combustion engines, reciprocating compressors, etc.).

Ask for Bulletin 8100.



SINGLE HELICAL and HERRINGBONE GEARS

Exclusive Falk extra-depth, high pressure angle gear teeth provide greater strength and protection against abrasion. AGMA ratings. Hub or ring gears in solid or split designs.

Diameters up to 23'-9" PD.

Face widths up to 6'.

Diametral Pitch: ¾ to 6 DP.

Ask for Engineering Reports 6170 and 6171

Ring Gears

Hub Gears

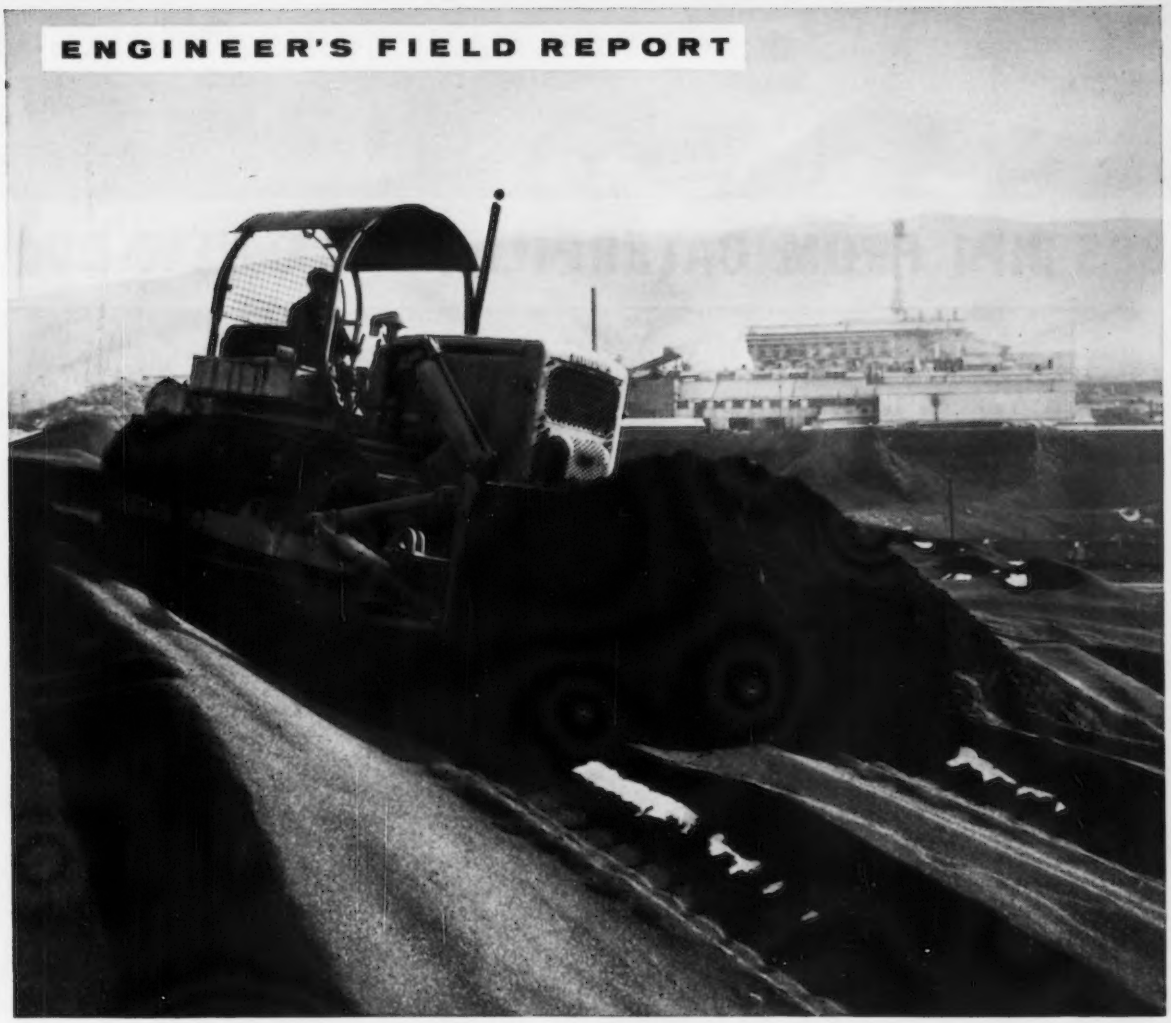
Special GEAR DRIVES for any application.

Special HIGH SPEED DRIVES . . . over 50,000 rpm.

Marine PROPULSION DRIVES for turbine and diesel.

FALK, ALL-MOTOR, and STEELFLEX are registered trademarks.

ENGINEER'S FIELD REPORT



100% overload... yet RPM DELO Oil cuts maintenance costs at Bunker Hill

Bunker Hill Mining Co., Kellogg, Idaho, is one of the world's largest miners of high-grade metals, producing over 500,000 tons of lead, zinc, and silver ore annually. And much of the work is done by diesel powered equipment ... using dependable RPM DELO Oils.

"We've reduced engine wear despite tough operating conditions," reports Shop Foreman Maurice Lyons. "Our diesel equipment often operates at 100% overload working with heavy materials like this granulated slag pile, above. Yet "RPM DELO" gives us the protection we need to keep equipment out of the shop and on the job."

RPM DELO Oil is one of 44 Standard Oil products used at Bunker Hill to lubricate over 25,000 pieces of equipment. The master lubrication plan for this huge fleet, prepared by Standard Engineers, has saved thousands of dollars in maintenance costs alone.

RPM DELO Oil reduces wear and prolongs engine life, protects vital parts whether engine is running or idle. Special detergent keeps parts clean, while anti-oxidant fights lacquer and gum formation problems. Other additives cut bearing corrosion and crankcase foaming.

Why not try RPM DELO Oil? Chances are it can cut your costs, lengthen equipment life. Just call your local representative, or write any company listed below:

LUBRICATING OILS RPM DELO

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20 • **STANDARD OIL COMPANY OF TEXAS,** El Paso
CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey - Denver, Colorado

TRADEMARK "RPM DELO" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

385 HP! FROM CATERPILLAR THE NEW D9G

MASSIVE HEAVY-DUTY UNDERCARRIAGE Immense strength and rigidity of undercarriage is one good solid reason why the D9G is more than equal to the roughest ripping job. Box section frame is wider and deeper than previous models. Hydraulic track adjusters are standard. Lifetime lubricated rollers with special alloy deep hardened rims assure long life . . . and they require no servicing until time to rebuild.

HIGH-PRODUCTION DOZER, PUSHER, RIPPER

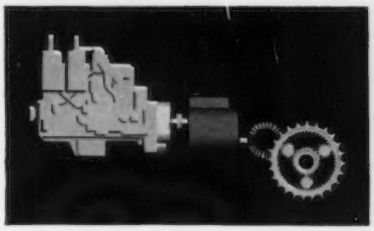
For high-volume dozing, pushloading or ripping, the new D9G has what it takes . . . at minimum cost per yard!

The engine in the new D9G delivers 385 flywheel horsepower. That's *100 more horsepower* than the first D9 introduced five years ago!

Weight is 64,800 pounds—14% more than the first D9!

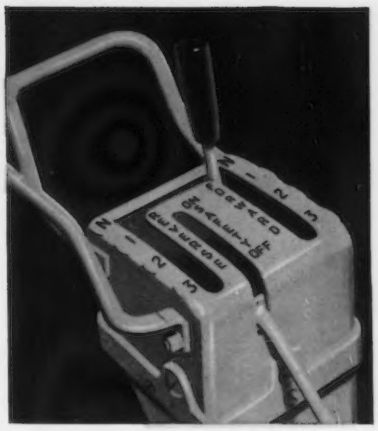
Torque divider power shift transmission . . . massive heavy-duty undercarriage . . . and power train with built-in ruggedness for long life.

What else is new? Matching the D9G is a full line of attachments—all designed to help this new tractor really put out on the toughest big jobs.



CAT D353 ENGINE AND MATCHED POWER TRAIN This engine, rated 385 HP (flywheel) at 1330 RPM, has been proven—and proven again—over thousands of hours on the roughest jobs. Its 6.25″ x 8″ six-cylinder design now incorporates *controlled turbocharging* and aftercooling (found only in the D9G among crawler tractors), assures more efficient use of fuel, increases maximum torque and provides fast engine response over a wide range of operation. Shroud-mounted fan reduces air recirculation; torque limiting clutch saves on fan horsepower. Plus: exclusive Caterpillar fuel injection system, twin dry-type air cleaners, oil-jet-cooled pistons, "Hi-Electro" hardened cylinder liners and crankshaft journals.

The new power train includes three major advances: *new oil-cooled steering clutches and brakes, new planetary final drives*, and a time and cost saving *common lube system*. The new spring-engaged, hydraulically-released steering clutches need no adjustments . . . have a proven longer service life. New, planetary final drives increase gear reduction ratios from 8.8:1 to 18:1, reducing torque load on all power train components. A common system cools and lubricates torque divider, transmission, bevel gear, steering clutches and brakes. This means one service point . . . one type of oil. The entire power train of the big new D9G has unitized construction for fast, individual removal of components.



PROVEN TORQUE DIVIDER POWER SHIFT This exclusive Caterpillar design feature—standard equipment on the D9G—combines the efficiency and snap of direct drive with the load-matching and anti-stall characteristics of torque converter. A single lever gives the operator finger-tip control of his machine. It adds up to fast cycle times and greater efficiency. You get more out of the machine *all day*.

A FULL LINE OF HIGH-PRODUCTION ATTACHMENTS New cable controls with larger clutch, brake and drum capacities—hydraulically boosted . . . new hydraulic controls in nine arrangements . . . special cushioned pushing equipment . . . angle, straight and U dozers, cable or hydraulic . . . rippers . . . scrapers . . . and others.

To prove the D9G's productive capabilities on your job, talk to your Caterpillar Dealer.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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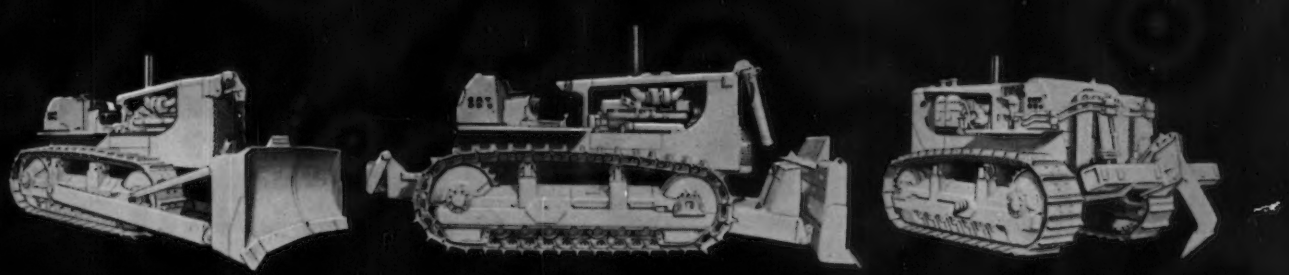
NEW D9G—BIG, POWERFUL, PRODUCTIVE

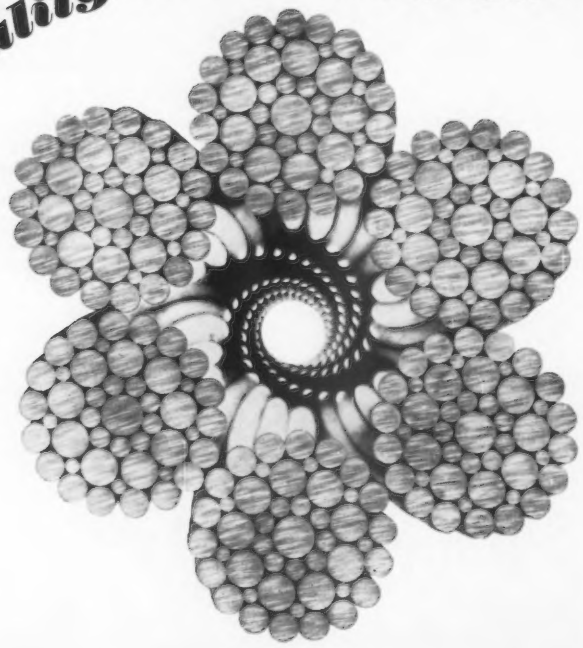


Any way you look at Roebling Royal Blue Wire Rope, there's real savings in it for you. In its inner and outer uniformity. In its *extra*-high strength. In unison, these qualities provide unrivalled resistance to abrasion, impact, crushing and tough sheave pressures. Royal Blue—inside and outside—goes on paying off for you when lesser wire rope would need replacing. Find out more from your wire rope distributor, or write for free booklet to Roebling's Wire Rope Division, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division
The Colorado Fuel and Iron Corporation.

quality inside and outside



We put a lot of work into it—
You get a lot of work out of it

RIPPER ACCOMMODATES ONE, two or three shanks as needed.

RIPPER RIDES CLEAR when not in use. Unit does not limit other tractor uses.

SOCKED TO FULL DEPTH, ripper utilizes tremendous power of TD-25. Rocks pry up and out.

RIPPER WEIGHT balances 'dozer, resulting in greater traction and more usable horsepower.

SLASH STRIP COSTS

Rugged Greenville Rippers mounted on International TD-15, TD-20 or TD-25 tractors get you down to the seam faster and often eliminate the need for explosives. You rip overburden free and push it directly onto the spoil bank.

In auger mines your tractor is completely equipped for face-up, pit preparation and road maintenance. Write for Bulletin GR-760 today. It gives complete data on Greenville Rippers and accessories.

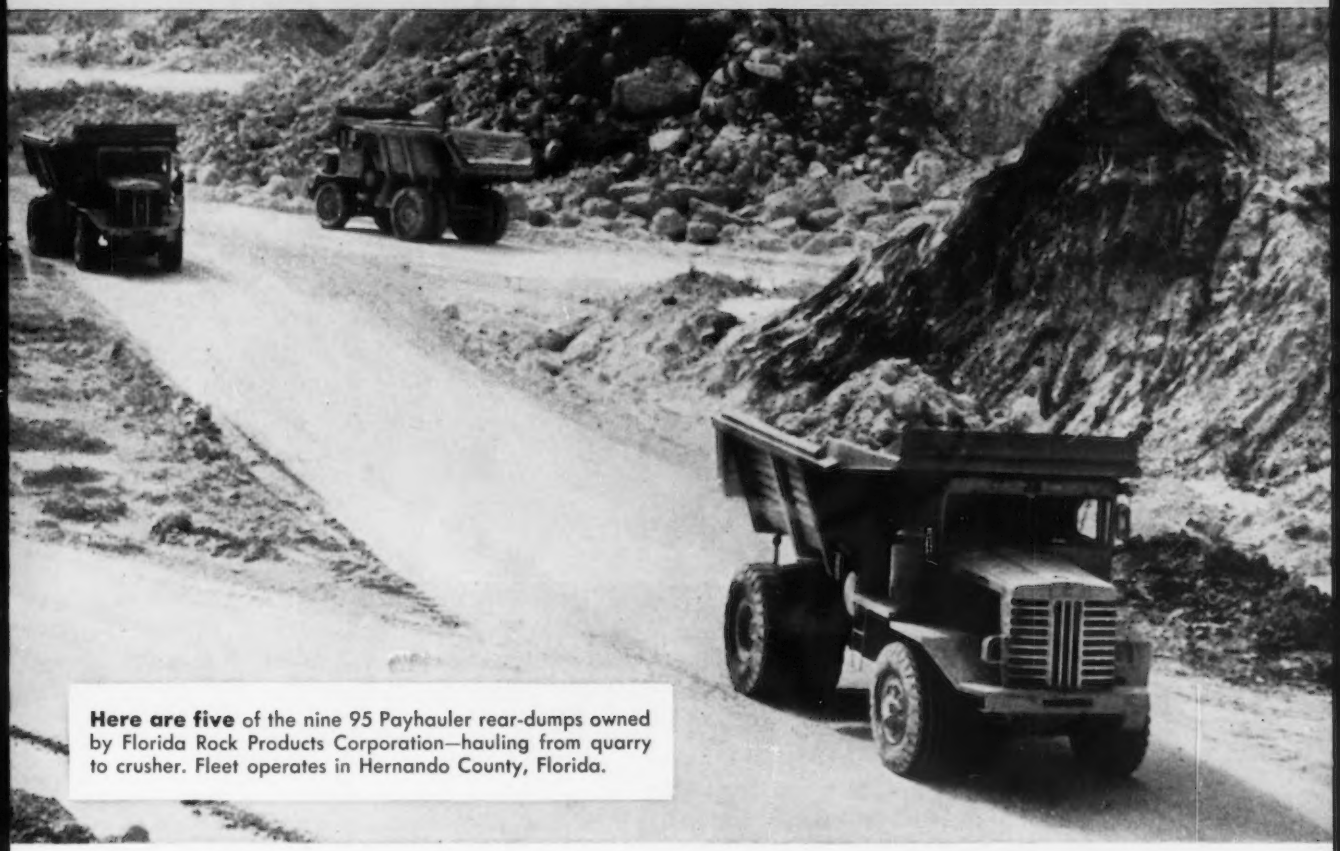
GREENVILLE STEEL CAR COMPANY

GREENVILLE, PENNSYLVANIA

Nine-Unit Payhauler fleet *serves*

Eleven-second dumping with positive power-up, power-down control of body action is provided by the inverted, double-acting hoist system as furnished by International. For similar all-around cycle-speeding advantages in a 19-tonner, see the 65 Payhauler!

Florida Rock Products Corporation



Here are five of the nine 95 Payhauler rear-dumps owned by Florida Rock Products Corporation—hauling from quarry to crusher. Fleet operates in Hernando County, Florida.

"Our Payhauler units are doing everything we expected of them—and are performing very satisfactorily."—T. S. BAKER, *President*
Florida Rock Products Corporation

Florida Rock Products Corporation moves rock from quarry to crusher with a fleet of nine International Model 95 Payhauler rear-dumps. Payhauler offers an exclusive combination of capacity-adding, cost-reducing features of special appeal for tough, heavy, off-road mine and quarry hauling.

Of all 27-ton off-road haulers, only the 95 Payhauler gives you the ton-shedding, brawn-boosting advantages of the rock-ribbed corrugated body. Only the "95" is plus-powered by the 375-hp DT-817 turbocharged International diesel engine. Choose the "95" with power-shift torque converter or 9-speed air-shift transmission.

Grade charts prove that the "95" Payhauler is in a class by itself for upgrade hauling—giving a speed advantage of up to 44%! Compared to 27-ton competitors, only the "95" is "one hand" power-steered with International's high-leverage enclosed system—or is quick-dumped (in 11 seconds) with power-up, power-down inverted hoist action.

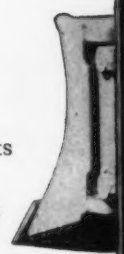
See for yourself in your own off-road hauling how an International Payhauler can increase your capacity, and give you record economy. Let your International Construction Equipment Distributor demonstrate.

International*® *Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

"C'mon...climb aboard

see how the new '15' beats the tracks off anything in its hp class"



"We want you to have first crack at this new workhorse that'll run rings around anything in its hp class—for the dirt it can 'doze, the bucks it can save, the aches it can end.

"It's the new International TD-15, and we guarantee it can show you in only 15 minutes why it heads up its hp class—and what that means to you in money in the bank!

"We'll show you how and why this new '15' can pick up and 'run' with loads that make other rigs sit and 'spin their tracks.'

"We'll show you 1961 operating ease, reliability, and speed—that can add up to a big bundle of cold cash in a season's run.

"We'll show you get-up-and-go that cuts 'dead-heading' back-up time as it's never been cut before—with the 6-speed, full-reverse transmission, and Shuttle-Bar direction changing.

"We'll prove to you—in your own language—that the new TD-15 can make you far more money, for more years, than anything in its horsepower class.

"C'mon in now and spend 15 minutes on a new '15'! Or call us for a demonstration on your job. See for yourself how it's tailored to your operation."

"Start the new '15's' 6-cylinder Diesel engine with push-button ease—see how you save warm-up minutes with International's famous gasoline-conversion starting. Compare the positive engine temperature control you get with pressure-type cooling and reserve capacity radiation."

International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

and bury the blade...

"Prove the new International TD-15 on full loads, part loads, intermittent loads. Prove it on jobs where *high torque* power and *long track* traction count."

engine power

BY CATERPILLAR

Here's a new profitable combination

Caterpillar-powered Gardner-Denver "Rota-Screw" portable air compressors reduce maintenance to lowest costs ever

Here is a major breakthrough in performance which means new low costs to users of compressed air. Gone are rotary blades or pistons. A helical "Rota-Screw" now eliminates blade chatter, vibration and whine. Quietness, pulsation-free air and minimum maintenance are the results.

Gardner-Denver's new SP900, a 900 CFM machine, is powered, as standard equipment, by the Cat D343 Diesel Engine. The SP600, a 600 CFM machine, is standard with the Cat D333 Diesel Engine. You get four-cycle design with full-stroke efficiency, plus full-length, watercooled cylinder liners for efficient cooling. Aluminum alloy pistons give low reciprocating weight, valve rotators distribute valve face wear and low-friction aluminum alloy bearings are known for superior strength and load carrying ability.

You'll like the Cat-powered Gardner-Denver line for the Caterpillar fuel system that provides "constant power" with *no* adjustments. Low-cost, high BTU fuels, such as household furnace oil, can be used instead of premium-cost No. 1 diesel fuel. Single orifice injectors and precombustion chamber design prevent fouling, even during long periods of idling between air demands. Electric glow plugs and ether starting arrangement are standard for quick, sure starts at below zero temperatures. Compressors are tested for a temperature range of –40° F. to 115° F.

Compressor service is available through a world-wide network of Gardner-Denver service points. In the U. S. alone there are over 5100 Caterpillar Dealer field service trucks on 24-hour-a-day call for engine service.

For more information on this new concept in compressors, write to the Gardner-Denver Company, Quincy, Illinois. Your nearby Caterpillar Dealer can tell you more about Cat Diesel and Natural Gas Engine Power for every application requiring from 50 to 950 HP, or write to Department 516, Engine Division, Caterpillar Tractor Co.

CATERPILLAR

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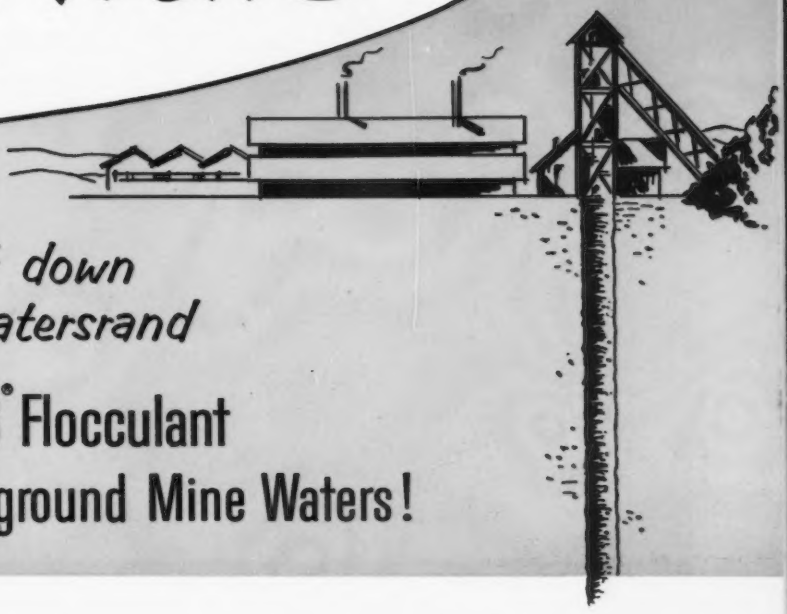
Engine Division, Caterpillar Tractor Co., Peoria, Ill., U. S. A.

CYANAMID

Reagent News

ore-dressing ideas you can use



10,000 feet down on the Witwatersrand

SUPERFLOC 16® Flocculant Clarifies Underground Mine Waters!

SUPERFLOC 16 Flocculant is now being used in South Africa in some of the world's deepest gold-uranium mines to remove sludge from water prior to pumping. Many of these mines extend down over 10,000 feet and pumping operations are carried out on a continuous basis. Through the use of SUPERFLOC 16, harmful solids are removed, increasing pump and pipe life and giving additional gold recovery in the settled sludge.

SUPERFLOC 16 is fed as a dilute solution into water at a point 50′ to 100′ back from the collector or sump. Flow in ditch or launder is sufficient for good mixing but occasionally baffles are used for added agitation.

At Mine A, settled sludge amounts to 40 tons/day assaying from 50 to 70 dwt gold/ton and worth upwards of $105,000 a month. Only 0.35 ppm SUPERFLOC 16 for treating 20 million gallons of water per day reduces solids content to 10 ppm. Additional saving: With erosion-causing solids removed, pumps previously overhauled every 1,000 to 2,000 hours are now serviced only once every two years.

At Mine B, SUPERFLOC 16 replaced a lime and alum combination and also reduced costs. There is no longer a lime scaling problem and solids removal is more effective.

At both of these operations adoption of SUPERFLOC 16 was based on results of trials with it and other competitive products. SUPERFLOC 16 outperformed all other products from a cost and performance point of view.

SUPERFLOC 16 may also help you clarify underground mine water or improve other solid-liquid separations with faster settling, better filtration and clearer overflow.

Samples and complete information are available from your nearest Cyanamid office.

AMERICAN CYANAMID COMPANY

EXPLOSIVES AND MINING CHEMICALS DEPARTMENT

CYANAMID INTERNATIONAL—*Mining Chemicals Department*

Cable Address:—Cyanamid, New York

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

CYANAMID INTER-AMERICAN CORP., Sucursal del Peru, Casilla 4393, Avenida Tacna 411, Lima Peru
SOUTH AFRICAN CYANAMID (PTY.) LTD., P.O. Box 7552, Johannesburg, Union of South Africa
CYANAMID OF CANADA LTD., Montreal, Quebec • Sales Offices: Toronto, Montreal, Vancouver
CYANAMID AUSTRALIA PTY. LTD., Atlas Building, 406 Collins Street, Melbourne, Australia
CYANAMID OF GREAT BRITAIN LTD., Bush House, Aldwych, London W.C. 2, England
CYANAMID DE MEXICO, S.A. de C.V., Apartado Postal 283, Mexico 1, D.F., Mexico
CYANAMID (FAR EAST) LTD., Central Post Office Box 1687, Tokyo, Japan

Cyanidation Process Chemicals • Flotation Reagents
Flocculating Agents
Film Forming Agents • Surface Active Agents

* * * * *

High Explosives • Permissibles
Seismograph Explosives
Blasting Agents • Blasting Caps
Electric Blasting Caps • Blasting Accessories

Yieldable Arches "give" to stabilize roof

Where conditions underground are unstable, Bethlehem's Yieldable Arch is often the best answer for dependable roof support. Utilizing the old technique of letting the enemy beat himself, the Arch yields gradually instead of steadfastly resisting, so that the overburden can settle into a natural arch of its own.

As long as pressures are excessive, the Yieldable Arch will continue to "give." As soon as stability is reached, the Arch holds the line.

A Yieldable Arch Set consists of curved U-shaped sections nested together and overlapped enough to permit clamping with husky U-bolt clamps. The clamps control the tightness in the joint, and permit yielding when the forces exceed the load for which the joint was intended. Each Arch set is connected to adjoining sets by means of horizontal struts, which add lateral rigidity to the structure.

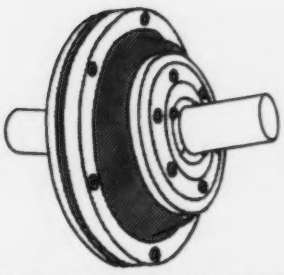
Besides increasing mine safety, the Yieldable Arch offers high salvageability, and usually pays for itself within its first year of service. A Bethlehem engineer would like to discuss the Yieldable Arch with you. You can reach him through the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales: Bethlehem Steel Export Corporation*

Steel *for Strength . . . Economy . . . Versatility*

BETHLEHEM STEEL

BETHLEHEM STEEL



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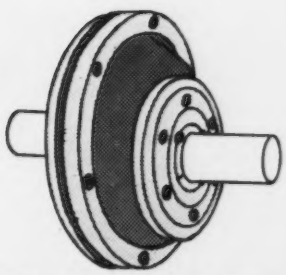

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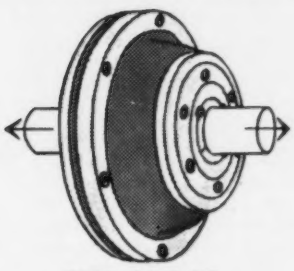

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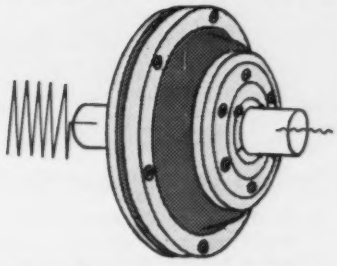


TORSIONAL VIBRATION

Dodge Improves Para-flex Couplings—Introduces Line's Largest Unit (48)

LAST FALL, Dodge Mfg. Corp. introduced a pan-shaped rubber flexing element which was featured in two new cushion-type couplings for high speed or high torque applications. At that time, the company said that the new couplings (Para-flex High Speed and Para-flex Flywheel types) were designed to operate at higher speeds and to transmit greater torque than the original Standard Para-flex which it had introduced in 1957.

According to Dodge, the new couplings accommodated, either singly or in any combination, angular and parallel shaft misalignment and end float, to absorb torsional vibration, and to cushion shock loads.

High Speed type had a flexible member supported on one side by a clamp-ring flange, and whose larger side was bolted to a steel disk. Both the flange and disk were equipped with Taper-Lock bushings for quick and easy mounting on shafts.

Flywheel type differed from the High Speed in that its larger side bolted directly to the flywheel of an internal combustion engine instead of being supported by a taper-bushed steel disk. The couplings were offered in sizes to fit the bolt circles of most standard SAE flywheels up to 19½-in. dia.

Flexing members of both the new types absorbed noise-producing vibrations and prevented electrical current flow between shafts—no metal to metal contact.

Now, Dodge is introducing a heavy duty flexible cushion coupling which is also designed for applications with high torque requirements and which is the largest unit in its Para-flex line.

Called PX280, it features the standard tire-shaped flexing element and has twice the torque capacity of the next smaller size. It will handle 400 hp per 100 rpm and its capacity at the recommended 910-rpm speed is 3,640 hp.

Dodge announced that the new coupling is available from stock with Taper-Lock bushings for shafts up to 7-in.-dia, or may be ordered bored-to-size for shafts as large as 9 in.

New Trailers (37)

SIX NEW high-capacity trailers have been introduced by Athey Products Corp. which, because they are constructed of "T-1" steel, provide increased capacity and faster haul speeds. Athey said the body sections are thinner—weight is reduced and greater payloads are possible. Increased horsepower rating of the Caterpillar tractors which pull them, as well as the addition of power shift transmissions, provide the greater traction power needed for the new trailers, and make handling on even the toughest hauls easier, faster, and more efficient.

Model PR619 is Athey's new 25-ton "T-1" steel rear dump. It works with Caterpillar's new 619 two-wheel tractor to give top haul speeds and extreme maneuverability.

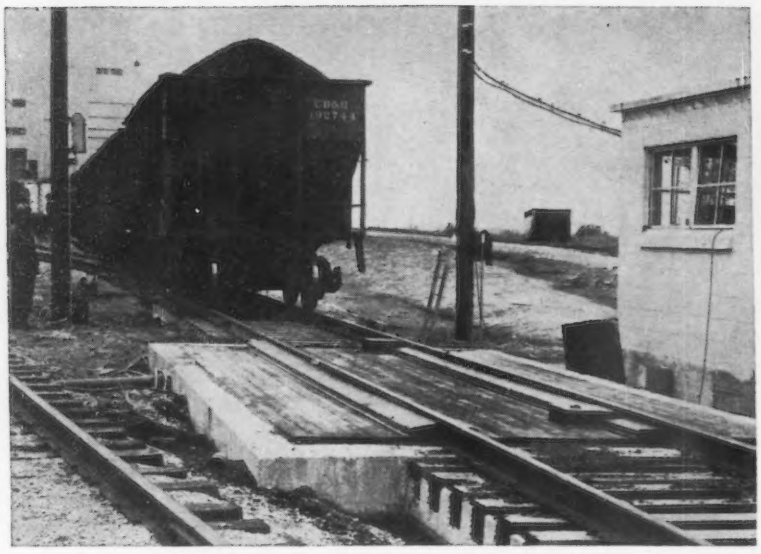
The 32-yd capacity PW630 is the company's latest bottom dump trailer. It teams up with Caterpillar's 420-hp 630 four-wheel tractor for high speed, big yardage production.

Improved Submersible Pump (7)

FULLY AUTOMATIC protection which eliminates the danger of motor burnouts has been incorporated into the latest pump series made by Sweden's Wedaverken for Motoramic Inc.

According to Motoramic, the feature also eliminates the need for an external starter—a costly and necessary extra on all other submersible pumps. The WEDA, with its built-in combination of starter and motor protector reduces the initial cost and reduces costly maintenance.

Motoramic added that WEDAMIC, a system that allows the operator to use WEDA pumps on either 220 v single-phase or 440/220 v three-phase without in any way altering the pumps, is being introduced for the first time.



Cars Weighed and Recorded in Three Seconds (2)

FAIRBANKS, MORSE & Co. have developed a unit which quickly weighs rail cars as they roll by—can balance and print out in less than three seconds.

The weigher, Model Q, registers as little as 60 lb (by 1/10-lb increments) or as much as 800,000 lb (200-lb jumps).

The machine's three-second recording period is constant but, depending upon the length of the scale-track, cars can move across the unit at speeds ranging from about 3 or 4 mph to 10-12 mph.

Model Q, according to Fairbanks, Morse, is a servo null-balance balancing system. The original signal comes from strain gage load cells. The servo mechanism detects a phase and drives a load-balancing potentiometer to a null-balance condition. When the machine arrives at that point, it prints out. The weight can be recorded on an adding machine, typewriter, tape or punch card equipment.

Redesigned Motor Scraper (29)

THE SMALLEST of Allis-Chalmers' all-hydraulic motor scrapers—TS-160—has been redesigned and restyled to increase the unit's capacity to eight and one-half struck and 11 cu yd heaped and the payload to 13 tons.

The new motor scraper has double-acting steering jacks and multiplier links to give it full power steering over the entire steering range—a 900, non-stop turn can be made in less than 25 ft.

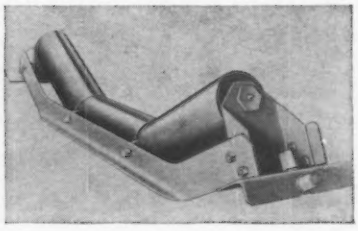
In addition to its other features, the TS-160 has the "Kon-Tork" differential which automatically controls the amount of torque delivered to each drive wheel in relation to traction requirements. It consists of only five moving parts for simple, dependable operation and provides maximum tractive effort in all types of material and conditions.

A-C said that the scraper (S-160) is interchageable with the body of the recently-introduced TR-160 dump wagon which has a 12-ton capacity.

Illuminated Clipboard (6)

MUTUAL ENGINEERING CO.'s improved illuminated clipboard permits careful records to be taken in totally dark or poorly lighted work areas. The new "Ray-Rite" has a two-battery head that provides excellent light distribution over the entire writing surface.

Mutual said that this unit eliminates the annoyance of having to carry both a flashlight and the customary clipboard and that it: saves time, promotes neatness, and can act as a flashlight alone —ends fumbling for light switches and doors.

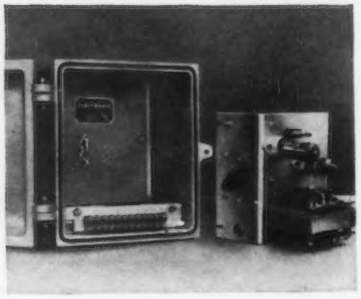


Troughing Idlers (11)

NEW TROUGHING idler which can be easily lubricated—six bearings lubricated from one grease fitting—on the idler frame—is now available from Hewitt-Robins for stringer conveyor systems.

The new idler, labeled Style L by H-R, has the following design advantages: easy disassembly—individual idler rolls can be removed by loosening four bolts at the end brackets; special double-length nuts—used for rope clamp and protecting bolt threads from corrosion and damage during handling; side bars that are flanged to furnish sturdy frame support for idler rolls; and idler rolls that are interchangeable—with welded construction available in four diameters (2¾, 4, 5, and 6 in.).

In addition to being easy to disassemble, Style L idlers can also be installed without difficulty. Both nuts of rope clamp stay on at all times.



Continuous Level Indication (9)

A CAPACITY operated monitor which provides a continuous level indication on a meter or recorder has been developed by Electronic Machine Co., Ltd.

The company said the new unit owes its stability and freedom from drift to a unique circuitry which uses a crystal oscillator with full temperature and mains compensation. A matched transmission line connects the instrument to its probe or transducer and cable lengths of up to 100 yd can be confidently used without stability loss—line is completely unaffected by metal girders along its run.

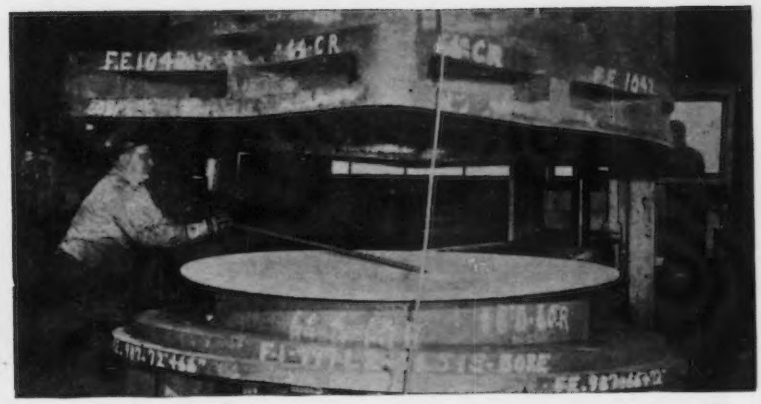
Called "Contimitor," the unit can be used as continuous level monitoring in tanks (where high minimum values of capacity are encountered) by having its coil tapped down at the probe end.

Form Rolled Titanium (14)

TITANIUM is getting more and more attention—primary producers are continually announcing refinements in properties and users are finding more and varied applications.

Englehard Industries' D. E. Makepiece Div. recently announced that they can supply titanium in a variety of shapes with tolerances to plus or minus .001 and controlled surface finishes to eight micro-in.

The elimination of all or most of the normal machining operations and resultant scrap associated with contoured stock is one of the advantages of the Makepiece form rolled which Englehard said has been used for blades and vanes in jet engines, steam turbines, nuclear fuel elements and rolled and butt-welded rings.



DISK OF TITANIUM-clad steel plate (66 in.) about to be pressed into a dished head, is part of Luken's first commercial-size titanium-clad order.

Lukens Ships 1½ Tons of Titanium—Sees Trend (5)

ANOTHER titanium breakthrough has been announced by Lukens Steel Co.—they have produced the first commercial-size order for E. I. DuPont.

Lukens feels that DuPont's one and one-half ton order (DuPont will use it for a processing plant reactor) is an indication of the future of titanium-clad plate for reactors, pressure vessels and tanks for the mineral processing, chemical and petroleum industries.

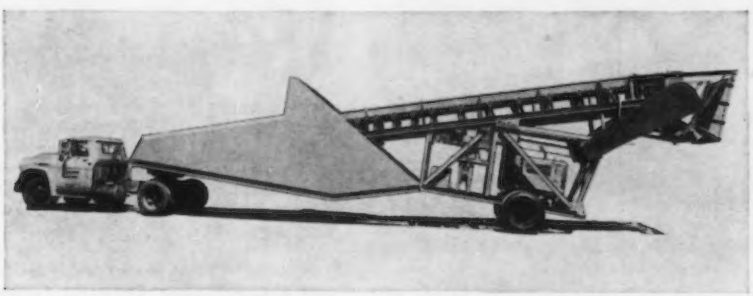
The company also said that at present, the titanium is not a standard production item and it is taking orders for titanium-clad on a development basis. It is available in plates up to 1¼-in. thick with a maximum titanium cladding of 3/16-in. Plate sizes run from four to eight ft wide and 12 to 24 ft long. The DuPont order included one plate (204 x 64½ x 5/8 in.) of 22% titanium on A-204 backing steel, plus one 66¼-in. pressed head of the same material.

Lukens said the main titanium problems were the impurities and brittleness that crept in when the process is stepped up from laboratory to production-scale operations. What finally worked was a technique Lukens said was virtually identical to the roll-bonding procedure it uses for other clad steels such as nickel and stainless. A four-deck pack of two layers of titanium is sandwiched between two plates of backing steel and is then hot rolled—bonding the titanium to the steel. The parting compound between the titanium layers permits separation into two clad plates after rolling.

The problem, though, was to keep both the steel and titanium surfaces absolutely clean and free from impurities (oxides and nitrates) which would impair the bond.

Company specialists found that the solution was to purge and flush the titanium and steel pack with argon gas during the six to 10-hr heating cycle before hot rolling.

Lukens said that by their technique, bonds have been produced with shear strengths exceeding the ASTM minimum requirement of 20,000 psi for stainless-clad steels.



Conveyor Loader Designed for Shallow Cuts (1)

KOEHRING Co. has introduced a heavy duty conveyor loader designed for dozer push charging in shallow cuts. The charging end of the new "Roughloader" has a low profile which makes it ideal for shallow cuts—and is strong enough to support both the dozer and the material it is dozing.

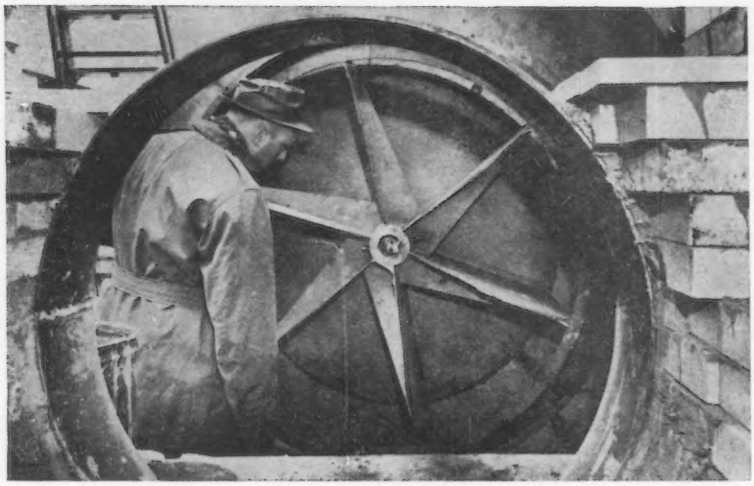
Koehring said that heavy duty troughing and impact carriers are closely spaced to handle boulders and compacted clayey chunks. Shaft and roll breakdown have been eliminated—power is applied to both sides for the head roll.

A built-in pin-type connection adapts to most standard tractors, permitting "Roughloader" to be pulled between jobs with ease.

Light, Maneuverable Truck (8)

MORE AND MORE ore transport manufacturers are cutting unit weight by using lighter yet high-strength steels. KW-Dart Truck Co. is not to be left out. Theyr'e now marketing the Model 32S truck built of Hi-tensile steel and which "reduces parasitic weight to a minimum."

The new truck's empty weight is 44,674 lb and it will be able to deliver 32 tons of payload on a short wheelbase, making it hugely maneuverable.



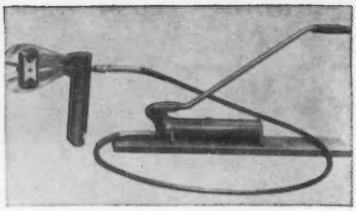
Titanium Exhaust Fan Withstands Corrosion (3)

TITANIUM FAN which exhausts a variety of highly corrosive gases at a Nassau Smelting & Refining Co. installation has already paid for itself and, according to Titanium Metals Corp. of America, will continue to pay for itself every 15 weeks.

Nassau's fan exhausts wet hydrochloric acid, ferric chloride, cupric chloride, and other extremely corrosive gases to a 120-ft stack. Carbon steel fans had previously been used (these failed in approximately one week of full operation) and each failure cost Nassau $1,100 (material—$400, downtime—$600, and labor—$100). The titanium fan and housing initially cost $17,000.

The 49-in. fan revolves at 800 rpm and is capable of exhausting 20,000 cu ft of gases from the furnace per minute. It weighs only 200 lb, as compared with the 425-lb unit it replaced.

A Nassau official said that "Since installation on January 15, the fan and housing have more than lived up to our expectations, providing excellent performance . . . no signs of corrosion after four months of uninterrupted service."



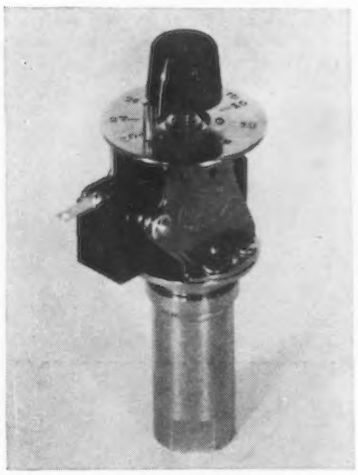
Hydraulic Wire Cutter (4)

H. K. PORTER CO.'s hand-hydraulic notched shear cutter solves the problem of having to cut elevator cable, wire rope or coarse stranded guy wire at work sites where outside power sources may not be available. The small hydraulic unit, 1790N, can easily be moved to scattered sites and cuts can be made overhead, on the ground, or in confined areas.

The machine's jaws are notched and lock the cable—minimizes crushing or deformation.

A remote control, hand-hydraulic pump forces fluid through a high-pressure hose to the ram assembly and delivers 25,000 psi cutting pressure on the blade's cutting edges. A by-pass valve, two filter screens, and a magnet in the pumps effectively prevent damage from overloading and assure long, trouble-free service.

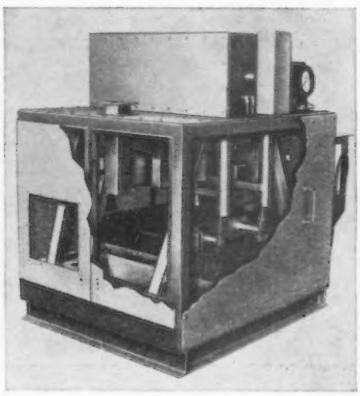
Porter manufactures two other cutter models. One, the Model 1790CD, will cut all types of soft or medium-hard rods, bars, and wire. The other, Model 179087, is a shear type cutter for copper and aluminum communication cable up to 2-in.-dia and a larger model, 179089, for cutting the 3-in. cable.



Pressure-Vacuum Control (13)

SMALL, LOW COST sensitive calibrated pressure-vacuum control which has no enclosure but is attached directly to the unit on which it will work, and which is designed for welding equipment, panelboards and process control equipment, is now being sold by United Electric Controls Co.

United said the unit weighs approximately 13 oz and that the switch action includes normally open, closed and double throw, and suitable for ambients up to 180° F.

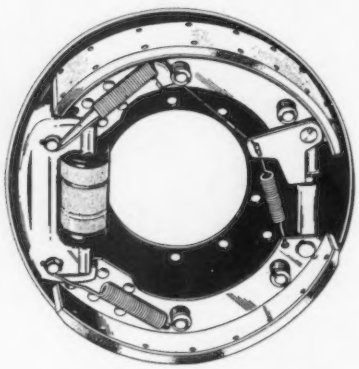


Dust-Free Weigher (10)

THAYER SCALE CORP. has developed a new continuous weigh feeder which automatically maintains a preset feed rate of ½ to 50 tph.

The new unit, called the CM12 system, has a feeder, conveyor belt, and a Thayer flexure plate scale. The belt and other components are completely suspended from the scale and are specially designed to prevent dust and material accumulation.

Because the CM12 uses the Thayer flexure plates in place of conventional knife-edge pivots, the weighing mechanism has no moving parts, and, Thayer said, maintains its precise accuracy indefinitely.



Self-Adjusting Brakes (12)

BENDIX DUO-SERVO self-adjusting brakes have become (since May 1) standard equipment for all LW-Adams motor graders from LeTourneau-Westinghouse's Indianapolis plant.

The adjuster operates when sufficient lining has been worn away to permit its lever to pick up the next tooth of the adjusting screw and turn it slightly.

Automatic adjustment takes place during a reverse brake application—prevents over-adjustment due to excessive drum expansion from repeated high speed forward brake stops.

For Your Files

This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.

GOODMAN MFG. CO. has published an extremely interesting and informative 26-page belt conveyor computations booklet which outlines a method for determining motor and belting requirements. The author, J. W. Hardy, said that the booklet furnishes "the men responsible for a mine's conveyor haulage system with information useful in meeting commonly encountered problems of horsepower and belting requirements."

Beginning with a discussion of underground belting requirements, Hardy goes on to analyze tonnage capacity of belt conveyors, belt computations, belt tension, and details of tensions on belt take-up devices.

In addition to the clearly-derived formulas, Goodman's presentation contains nomographs which determine: conveyor belt width; horsepower at motor shaft per 1000 ft of conveyor length for 30-, 36-, and 42-in. horizontal conveyors; and horsepower at motor shaft to raise or lower load on slope conveyors. **(92)**

FINE COMPANION piece to the Goodman primer is Hewitt-Robins' booklet on mining belt conveyor operating maintenance hints.

According to the company, the purpose of the booklet is to present, in ready reference tabular form, some of the more common belt conveyor maintenance problems, their causes, and methods that have been proven effective in correcting them.

Sections cover erection of belt conveyors, training the belt, tension, lagging, loading points, fire hazard, inspection and examination, storage and splicing. H-R then lists 18 specific conveyor problems together with their cause and correction. **(93)**

48-PAGE reference manual for cables insulated with OKONEX butyl-base high voltage insulation has just been issued by the Okonite Co., wire and cable manufacturing subsidiary of Kennecott Copper Corp.

Okonite's insulation is extremely resistant to ozone, heat and moisture, and cables covered with it can carry heavier loads for a given size conductor or the same load on a smaller size conductor. **(94)**

KAISER Refractories & Chemicals Div. has published a newly-revised 24-page booklet describing the physical characteristics of a variety of castable refractories and their application.

A full range of products for furnaces in the 700° to 3500°F zone is outlined in the booklet. Also described are the products' characteristics designed to meet the special conditions imposed on refractories by the demands of furnace operation, atmospheres, fuels and service conditions. **(95)**

COLEMAN CABLE & WIRE CO. has just published an index card, "Wire for the Explosives Industry," to which are attached seven types of blasting cord: connecting wire, bus wire, two types of leading wire, and two shot firing cords. **(96)**

THE NOLAN CO., manufacturer of railway and industrial equipment, has prepared an 18-page catalog which illustrates and describes a variety of new products. The new Nolan products include all-steel push cars, tool and supply car, track dolly carry-cart, rail dolly, bumping posts. The catalog also reviews Nolan's standard line of rerailers, derailers, car door openers, and other railroad items. **(97)**

HYDROCONE crushers with Hydroset controls are described in a new bulletin (17B9923) from Allis-Chalmers.

A-C said that the 22- and 30-in. units are designed with a complete range of chambers for coarse, intermediate or fine crushing, and are available with feed openings to 5 in. and capacities to 68 tph. **(98)**

VASCOLOY-RAMET Corp.'s new catalog VR-500 outlines a complete line of carbide tipped percussion bits for all types of rock drilling, quarrying and open pit mining.

Included in the V-R presentation are bottoming and shoulder bits in all popular threads, down-the-hole bits for splined or API thread connections and push-on style bits. All are available in a wide range of diameters. Charts help pick proper bit for any job. **(99)**

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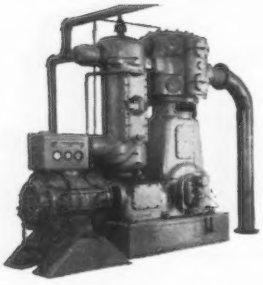
Free! NEW GUIDE AND CONDENSED MANUAL: "PRIMACORD DETONATING FUSE . . . WHAT IT IS . . . HOW TO USE IT." ASK YOUR EXPLOSIVES MANUFACTURER OR WRITE US GIVING YOUR COMPANY NAME.

Which... ATLAS COPCO COMPRESSOR

meets your needs best?



AR Heavy-Duty Compressors

More air per horsepower than any comparable compressor! For continuous, full-load operation. "L" angle, 2-stage, double acting. Water cooled. Standard models provide 382 to 3210 cfm free-air delivery at 100 psi; only 76-590 hp required! (Can be supplied for other working pressures on request.)

What's your compressor requirement? Need an installation large enough to provide air for all your needs? Or would a small, compact unit for auxiliary operation solve your immediate problem? Either way—and for a wide range of applications between these extremes—Atlas Copco has the compressor for you!

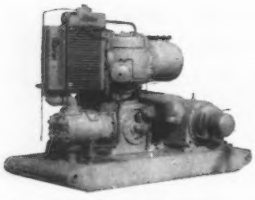
No matter which you choose, you'll get these proven advantages from Atlas Copco:

(1) More air per horsepower—less power consumption than other comparable units!

(2) Really low maintenance (one example — $3.10 after 10,000 hours' operation)!

(3) Specifications are guaranteed free-air delivery — you get exactly what you order!

Get all the facts now—and compare! The coupon below will bring you a free catalog. (No obligation, of course.)

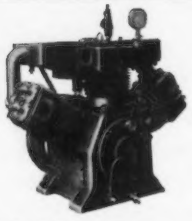


AR-L Heavy-Duty Compressors

Same basic construction as the AR Series, but provided with an air-cooled intercooler and air-cooled radiator for the cylinder water. Fan on compressor flywheel cools radiators. Perfect for arid areas or where difficult to bring in water. Both stationary and skid-mounted models available.

TWIN-AIR Rotary Screw Compressors

Brand new! "Twin-Air" Compressors offer capacities from 6,900 to 19,400 cfm at working pressures up to 115 psi. And, you get completely *oil-free* delivery of air or gas, since no lubrication is required — timing gears maintain small clearances between precision-mounted rotors, eliminating friction (and the necessity of oil) in compression chamber.



CT Air-Cooled Compressors

Stationary, or skid-mounted compressors for use where air demand is between 50 and 300 cfm. Totally air-cooled. Cylinder arrangement designed for smooth, vibration-free operation. Compact, rugged—for continuous, 24-hour trouble-free service. Highly efficient; low on maintenance costs.

ER-6 Heavy-Duty Compressors

New! Fundamental improvements over conventional heavy-duty compressors reduce power requirements (18.3 hp/100 cfm at 100 psi, full load); provide totally enclosed design; and save on floor space. Capacities to 1,140 cfm; standard instruments and safety devices.

ATLAS COPCO
New York 17, N. Y.
Dept. EMJ-60-5, 545 Fifth Avenue,
Gentlemen:
Please send me ☐ Short-form catalog ☐ Detailed information on the____Series

Name_____ Title_____

Firm_____

Address_____

City_____ Zone____ State_____

Atlas Copco

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

JOE IS PROUD OF HIS NEW BABY!

Good reason, too! He's got a 9-inch down-the-hole bit from Sandvik-Coromant, and that means he's got a bit that's better than he's ever used before!

Strong statement? Sure. But here's proof:

First, Sandvik is one of the world's largest and most experienced manufacturers of tungsten carbide. Therefore, Joe gets the highest quality carbide possible. From more effective refining, through better mixing, to more careful control of grain size—everything possible is done to assure Joe longer bit life and more feet between sharpenings.

More proof: Sandvik carbide inserts *stay in*, thanks to our unique brazing method. And since the entire bit is made from Swedish steel—Joe knows breakage won't be a problem.

You'll be happy with Sandvik-Coromant down-the-hole bits, too. They're available from 4¾ to 9 inches in diameter, and for all types of rigs. Get in touch with your nearest Atlas Copco office today, or write to Dept. EMJ-61-2

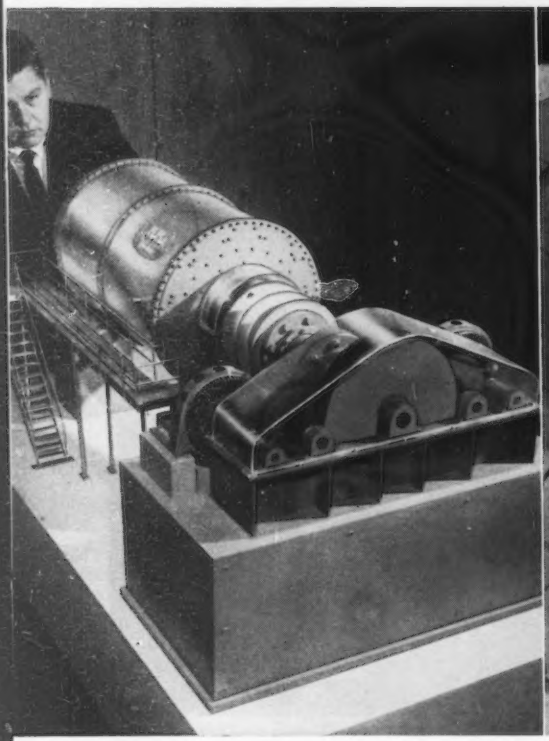
Better refining, mixing and over-all quality control by Sandvik means best carbide possible. And a special brazing method locks the inserts in to stay!

Sandvik down-the-hole bit bodies are made from Swedish steel by Swedish craftsmen. Result: less breakage...longer life!

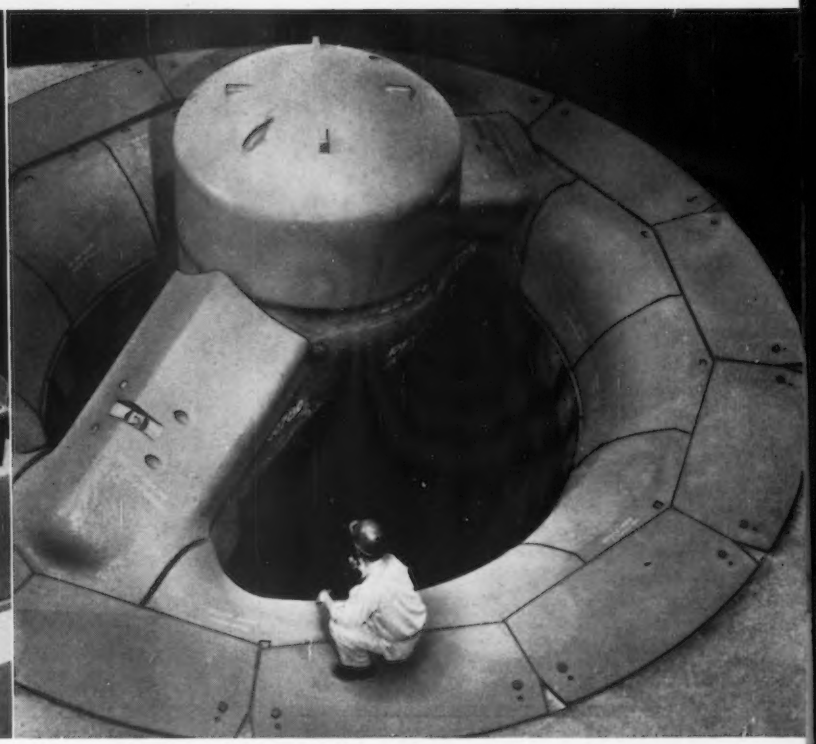
Atlas Copco Inc.

610 Industrial Avenue, Paramus, New Jersey • COlfax 1-6800
930 Brittan Avenue, San Carlos, California • LYtell 1-0375

ideas and news:



Latest step in mill trunnion drive evolution: New TWINDUCER drive divides mill load electrically between twin synchronous motors. Compared to trunnion drives with mechanically divided load, the TWINDUCER drive requires 50% less space. Since there are no floating gears or pinions, gear wear is kept to a minimum. TWINDUCER drive fits any plans for automatic grinding operation.



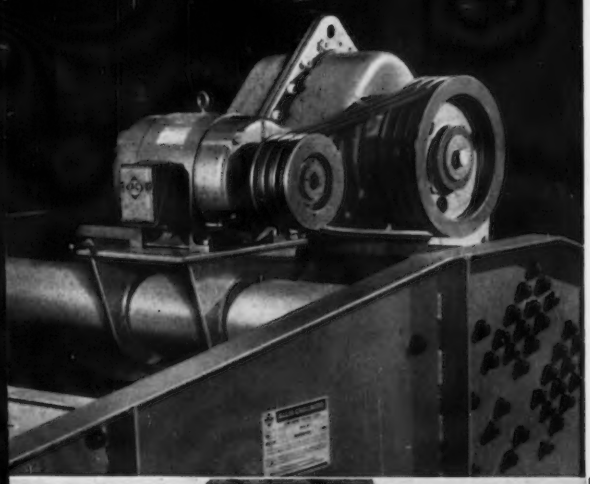
World's largest crusher to be duplicated: Because it has achieved very favorable results in expanding production and lowering operating costs, this giant Allis-Chalmers crusher will soon have a running mate. Scheduled for installation at the same ore reduction plant is an identical 60-109 SUPERIOR crusher with HYDROSET mechanism. Allis-Chalmers will also furnish two 500-hp motors, four 30-70 SUPERIOR secondary crushers, and four 300-hp motors for the installation. Drive motors and crushers are designed together . . . built together at A-C.

Which of these productive ideas could be working for you?

Larger, more efficient crushers and screens. Easily maintained switchgear. Reliable substations. These examples demonstrate the extra value that is standard with A-C . . . the greater efficiency and the added productivity which are yours when you buy A-C products, systems and services. Call your Allis-Chalmers representative for details on A-C "worth-more" features. Or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.

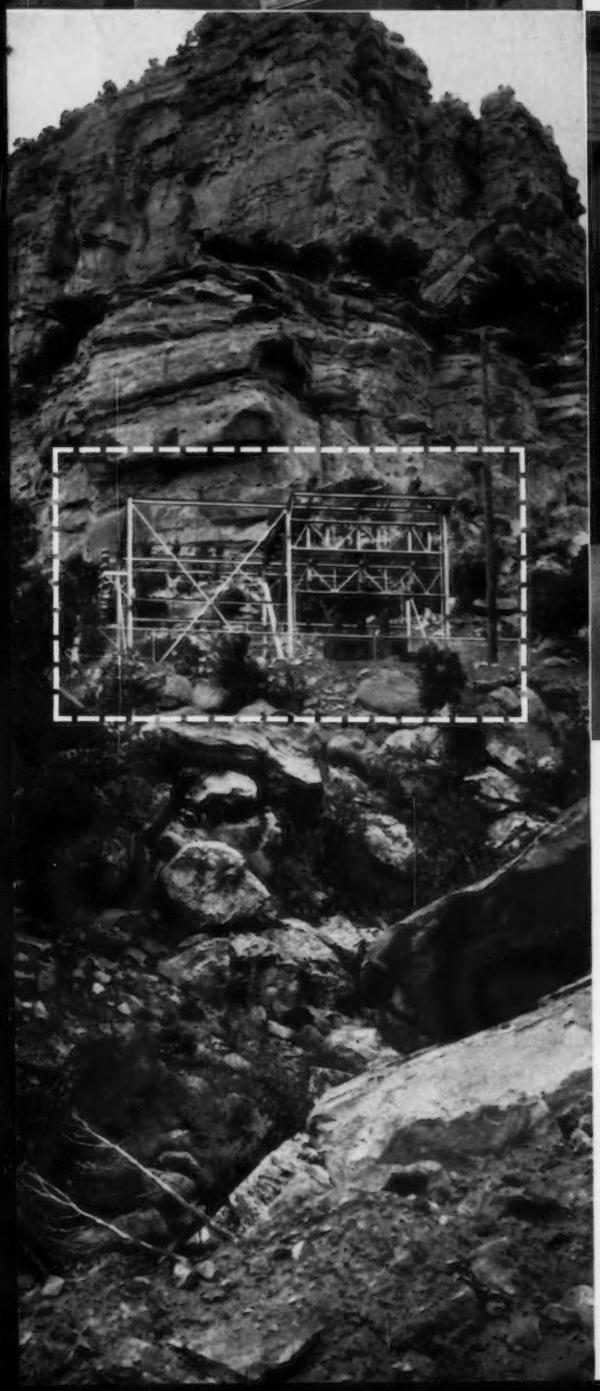
Twinducer, Superior, Hydroset and Low-Head are Allis-Chalmers trademarks.

A-1481



Low-Head screen with direct mounted motor — A completely integrated screening unit is this new, LOW-HEAD horizontal screen with direct mounted motor. No supporting structure, no belt tensioning or alignment problems plus headroom saving, smooth starts and stops, easy accessibility for maintenance. Another example of engineered screening from Allis-Chalmers.

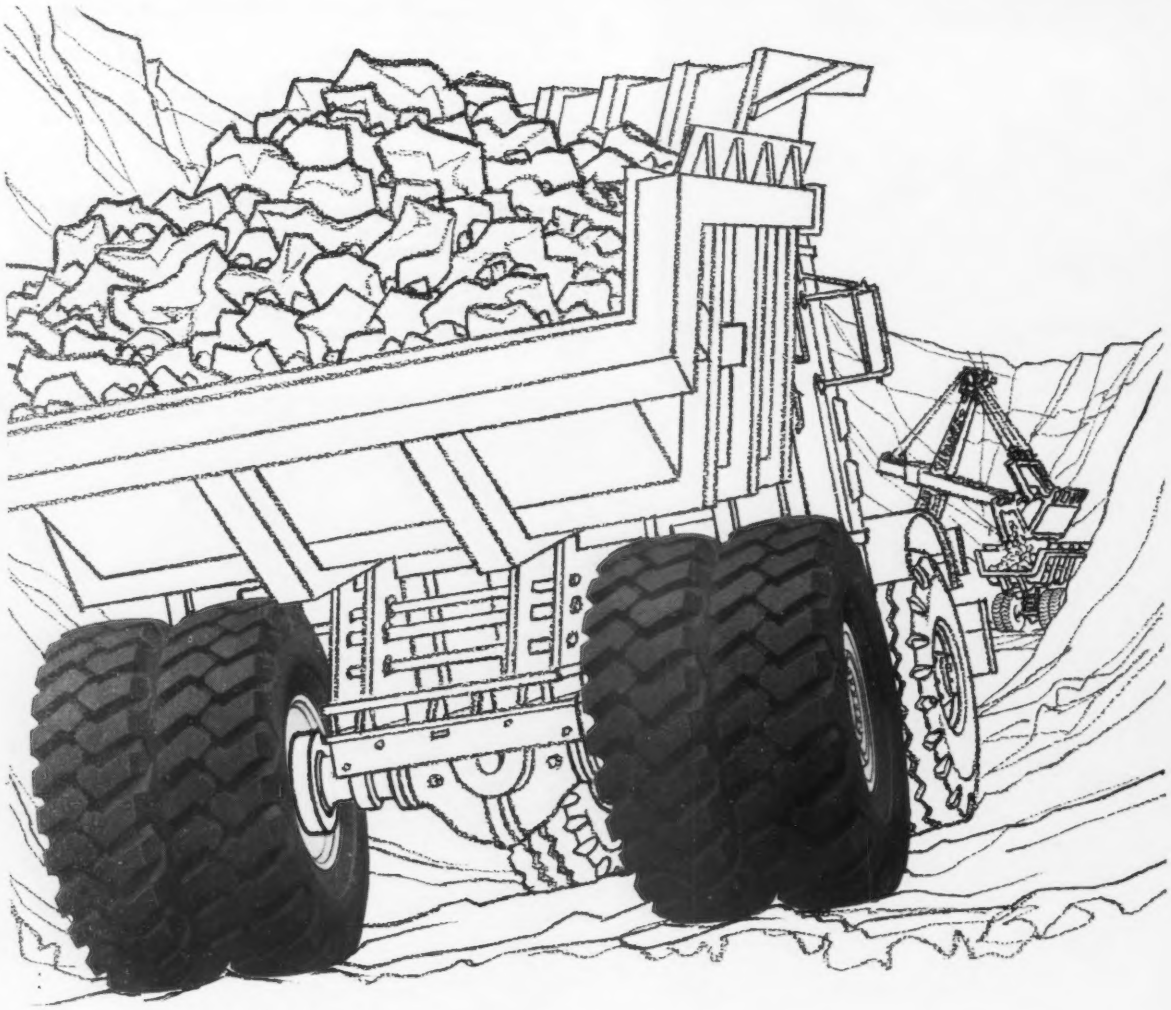
Lowest height, easiest access 5-kv metal-clad switchgear on the market. Just 72 inches high. You get eye-level instrumentation, shoulder-height accessibility of component parts. Other outstanding advantages: front-accessible current transformers; maximum compartmentation and dead-front construction for greater safety; full-panel metering; rapid, one-stroke breaker insertion. Choice of stored energy or solenoid operation.



Reliable performance that's one mile high: This A-C substation has completed about five years' service 6546 feet up the remote Wasatch mountains of eastern Utah. Equipment survived rugged transportation up the mountain side on steel skids or trucks over rough bulldozed road. One switchgear fell from truck but was not damaged beyond a few dents. Picked to give dependable performance in this inaccessible, practically unserviceable location, A-C substation has proved out well beyond expected performance.

ALLIS-CHALMERS PRODUCTS: Look to Allis-Chalmers for compressors, controls, crushers, earth-moving equipment, electrical distribution equipment, engines, generators, industrial systems, kilns, lift trucks, mills, motors, pumps, rectifiers, screens; thermal, hydro and atomic electrical generating equipment; tractors, transformers, unit substations.

ALLIS-CHALMERS



Shock-Fortified Firestone Tires Mean

LESS DOWNTIME and MORE RECAPS!

Your quarry trucks will boost their production and beat downtime on Firestone SUPER ROCK GRIP DEEP TREAD tires. With 50% deeper treads of Firestone Rubber-X, they fight off cuts and bruises. This tough tread rubber goes all the way through to the cord, and offers a long-wearing base for extra money-saving recaps! You get more built-in impact resistance with Firestone's new Shock-Fortified cord bodies of bonus-ply nylon. Get the downtime protection that's built into Firestone quarry tires—plus fast, on-the-job service—from your nearby Firestone Dealer or Store.

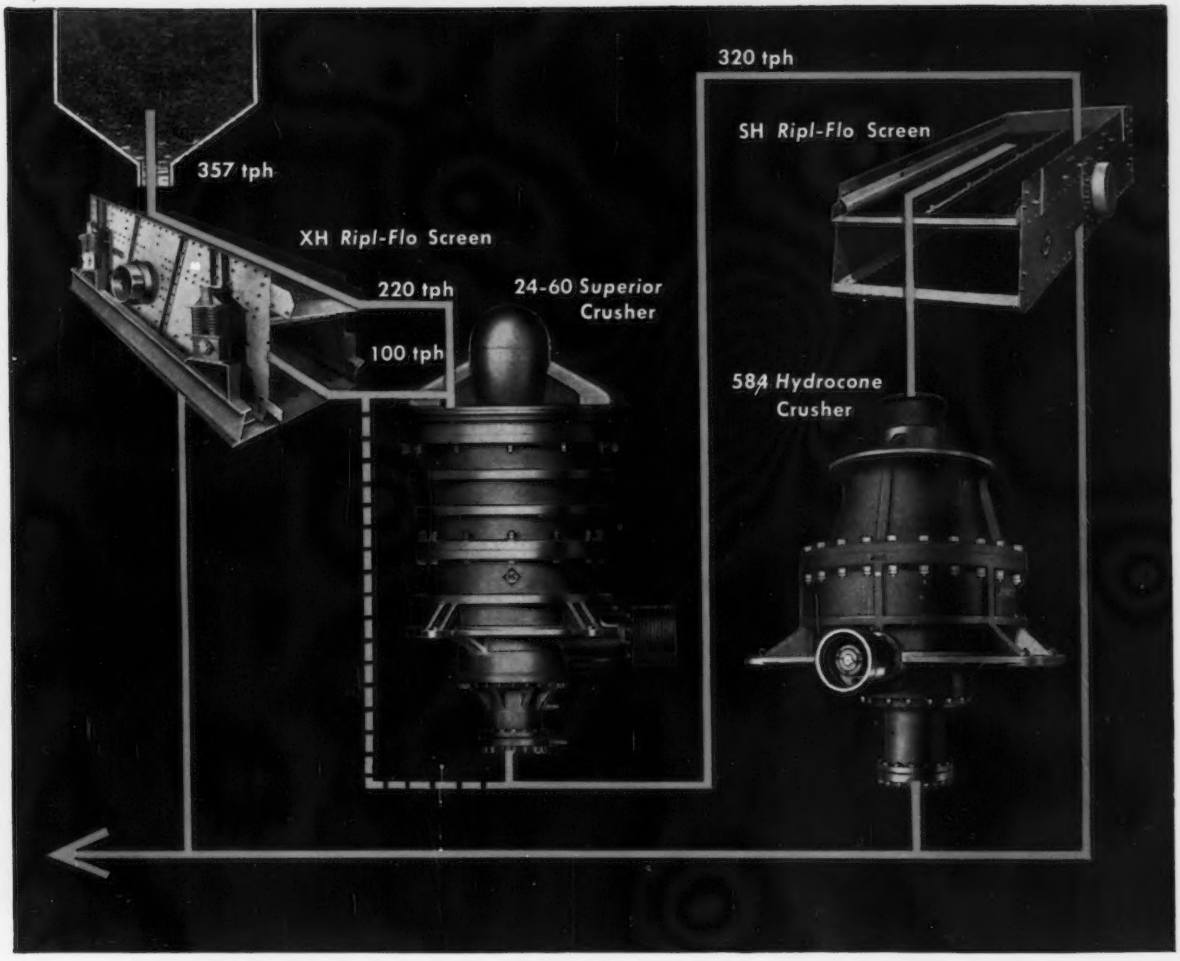
Always Specify Firestone Tires When Ordering New Equipment.

Firestone

FIRST IN OFF-THE-HIGHWAY TIRE NEEDS

Copyright 1961, The Firestone Tire & Rubber Company

ALLIS-CHALMERS



King-size crushing job—from 16″ feed to ¾″ product—with

two crushers instead of three

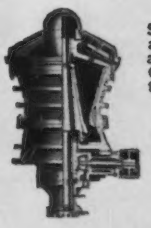
Two important efficiency factors were the key to a new installation in Southwest "copper country."

First of all, only Allis-Chalmers could furnish the right-sized crushers to do the job. A 24-60 *Superior* gyratory is the primary crusher for reducing raw 16″ ore down to 2½″. Final crushing, down to ¾″, calls for a 584 fine chamber *Hydrocone* crusher. It's normally a job for three crushers — but these two do the job dependably . . . and both are equipped with time-saving *Hydroset* controls.

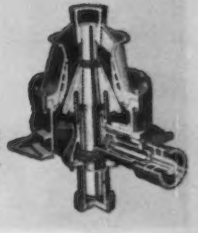
Secondly, A-C engineering service specializes in designing plant flows that bring out the best in equipment . . . designed for maximum efficiency, step by step, from bin to storage pile.

Ask your A-C representative about complete engineering service and the size range of A-C crushers. Or write **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1335

Superior, Hydrocone, Hydroset and Ripl-Flo are Allis-Chalmers trademarks.



SUPERIOR gyratory crushers are built for rugged primary and secondary crushing loads. Capacities from 170 to 3500 tph. Twelve sizes.

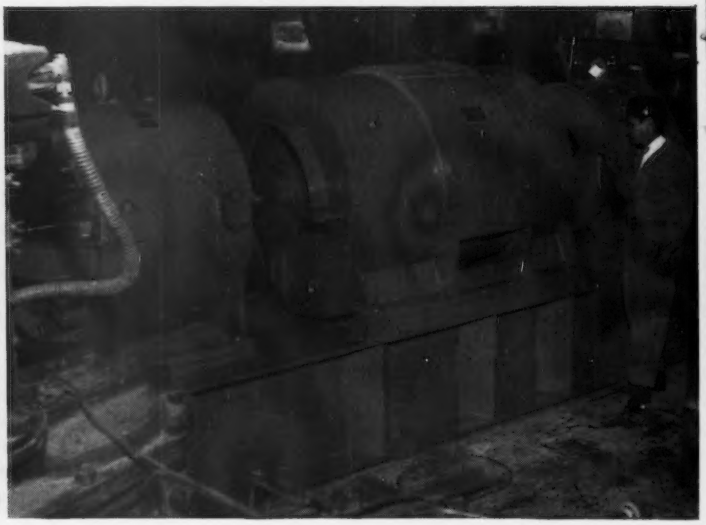


HYDROCONE crushers, built to economize on secondary and tertiary stages, have capacities from 7 to 1050 tph. Twenty-one sizes.

Wheel excavator removes top overburden at Peabody Coal's Freeburg, Ill., strip coal mine. Main drive elements are: 1. Wheel drive motor, 2. Crowd motor, 3. Digging ladder conveyor motor, 4. Propel motors, 5. Motor-generator sets, 6. Stacker conveyor motors, 7. Ladder hoist motor.

100 hp, a-c Westinghouse motor used for crowd motion.

One of two 1000 hp, 4 unit synchronous Westinghouse motor-generator sets with split frame generators and split bracket motor for full accessibility.



IN OPEN PIT OPERATIONS WESTINGHOUSE MOTORS AND WHEEL EXCAVATOR MAKE POWERFUL TEAM

As ratio of overburden thickness to coal seam thickness hits 20:1 or more (a 10:1 ratio was considered to be a break-even point only a few years ago), open pit operators continually search for new methods to remove overburden more economically.

An example of how one operator is tackling the problem is the Peabody Coal Company operation at its River King mine, Freeburg, Illinois. Peabody has teamed up a giant new wheel excavator with a large stripping shovel. The wheel excavator, manufactured by Bucyrus-Erie Company and exclusively powered by Westinghouse motors, removes the dirt and clay of the overburden. Behind the wheel excavator, the shovel scoops out the shale and hard rock to expose the coal seam.

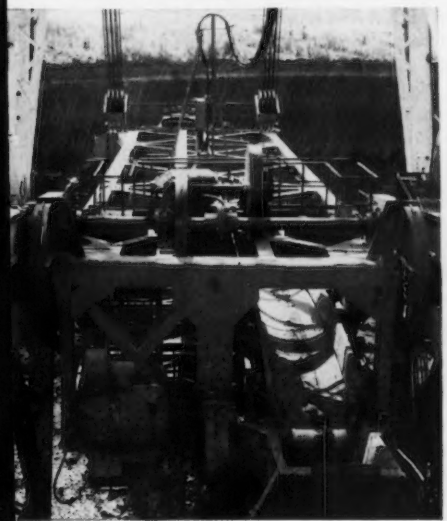
Preliminary operations indicate that this "tandem" arrangement is much more efficient than a shovel working alone. But, an important part of the forecasted savings originates with the design and operation of the new wheel excavator itself.

It is capable of moving 3000 cubic yards of dirt per hour and depositing it 400 feet from the digging wheel to the spoil bank. Its crowd motion is up to 45 feet and driven by a 100 hp Westinghouse Lifeline a-c wound rotor motor with a-c reversing starters. This particular motor is well suited to the severe reversing, plugging service and frequent stopping and starting. The motor's rugged frame and feet assure maximum strength and rigidity to shock, vibration and physical abuse. The ladder hoist range of the wheel excavator is 40 to 100 feet at 15° angle and the motion is powered by a 150-300 hp Westinghouse d-c motor. A 90 foot long ladder conveyor operates continuously at 945 fpm and is driven by a 187.5-375 hp Westinghouse d-c motor. The Stacker conveyor extends 327 feet, moves faster (1260 fpm) than ladder conveyor to avoid pile-up of dirt at transfer point. This stacker conveyor and wheel employs two 250-500 ph Westinghouse d-c motors.

Swing motion of the new machine is operated by two 25-50 hp Westinghouse d-c motors. Low inertia armatures, greater field coil capacity, more torque per ampere — all features of Westinghouse motors — are particularly advantageous for this motion by allowing acceleration, deceleration, start, stop and reverse with a minimum of time and power. Exclusive Westinghouse insulation systems give maximum life and protection; mechanical designs include easily accessible motor leads, split steel frame d-c shovel type motors, steel shell field coil construction, maximum diameter shafts through punchings and with no overhung commutators.

The 3,200,000 lb, 410 ft long, 180 ft high wheel excavator is propelled forward or reverse by four 100 hp, a-c Westinghouse motors, known throughout industry for reliability under tough operating conditions.

If you need information on how Westinghouse electrical equipment can help you realize greater operating efficiency at lower cost, see your Westinghouse sales engineer or write: Westinghouse Electric Corporation, Box 868, Pittsburgh 22, Pa. *You can be sure . . . if it's Westinghouse.*



187½ hp forced ventilated d-c digging ladder conveyor Westinghouse motor (center, left) and 100 hp, a-c Westinghouse crowd motor (rear).

Westinghouse

J-96174

in uranium ore processing...

TRONA®
SODIUM CHLORATE!

out-performs other oxidizing agents because of higher oxidizing power, economy and ease of handling

Experience proves that TRONA SODIUM CHLORATE is the best oxidizing agent you can use in the acid-leach process for recovering uranium values from its ores. $NaC10_3$ is more economical, too, because of its higher oxidizing power. It is rapidly and completely soluble; in the leaching circuit it forms a solution, not a suspension. Another advantage—Trona sodium chlorate shipping drums are suitable for re-use in shipping yellow cake. AP&CC, the largest domestic producer of sodium chlorate, has the knowledge, experience and facilities to produce a consistently better sodium chlorate for your milling operations.

TRONA® SODA ASH is used in acid and alkaline processes for the refining of uranium ores and as a pH modifier in the ore milling circuit. High quality Trona soda ash has applications also in the refining of lead dross and as an extractant of nonferrous minerals from low percentage ores by flotation.

Write for $NaClO_3$ facilities, technical data and applications bulletin. Also available —an attractive and functional wall chart for chlorate handling precautions.

TRONA

American Potash & Chemical Corporation

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Producers of: BORAX • POTASH • SODA ASH • SALT CAKE • LITHIUM • BROMINE • CHLORATES • PERCHLORATES • THORIUM YTTRIUM • RARE EARTHS • *and other diversified chemicals for Industry and Agriculture*

How Nello L. Teer Co. cuts tractor costs at sand and gravel pit

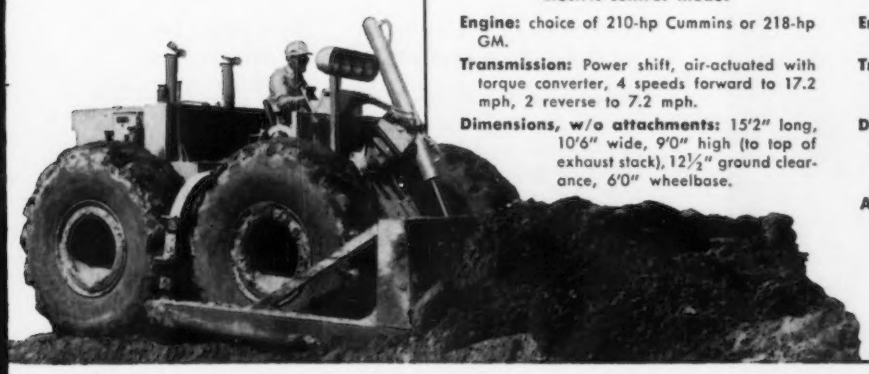
The Nello L. Teer Company of Durham, North Carolina, gets a lot for its money with the LW Tournatractor® it uses at its 60-acre sand-and-gravel pit near Erwin, N.C. Working in a 4-mile radius, this rubber-tired tractor maintains haul roads, stockpiles sand, dozes material into hoppers, pushes rail cars . . . handles any and *all* tractor work. Tournatractor often covers up to 100 miles in a 10-hr day.

You'd expect high-maintenance costs for a tractor assigned to a schedule like this. But not for Tournatractor! Notice the tires. With over 870 hours on them, they still look like new, *have been trouble free.* Electrics? "They give us no trouble at all," reports operator J. T. Byrd, "we haven't even changed the contact points. This tractor sure is *economical to run and it does a grand job!*"

Better protected from grit and wear

The mechanical parts in Tournatractor are protected from grit and wear . . . giving Nello L. Teer higher efficiency, with more hours of *continuous* tractor service. Tournatractor gets high efficiency through its enclosed anti-friction drive and fewer moving parts, and in many materials this tractor's big, low-pressure tires outwear tracks by as much as 2-to-1. In highly abrasive materials, tires often give up to 4 times the service of tracks. What's more, time-consuming track-assembly lubrications are eliminated.

Let us show you how Tournatractor can help *you* increase output and lower your operating costs. We will be glad to arrange a demonstration.



NOW . . . A CHOICE OF TOURNATRACTORS LeTourneau-Westinghouse now offers you a choice of Tournatractors: electric control (shown above) . . . or hydraulic blade control (shown below). Here are quick specifications:

Electric-control model

Engine: choice of 210-hp Cummins or 218-hp GM.

Transmission: Power shift, air-actuated with torque converter, 4 speeds forward to 17.2 mph, 2 reverse to 7.2 mph.

Dimensions, w/o attachments: 15'2" long, 10'6" wide, 9'0" high (to top of exhaust stack), 12½" ground clearance, 6'0" wheelbase.

Hydraulic blade control

Engine: GM V-Power diesel (6V-71) producing 218 hp.

Transmission: Power shift, air-actuated with torque converter, 4 speeds forward to 18.5 mph, 2 reverse to 6.2 mph.

Dimensions, w/o attachments: 13'6" long, 10'6" wide, 7'8" high (to top of exhaust stack), 15¾" ground clearance, 6'0" wheelbase.

Attachments (both models): Bulldozer and Angledozer® blade, coal blade, rock blade, snow plow, front and rear push blocks, root rake, and rear-mounted RR coupler.

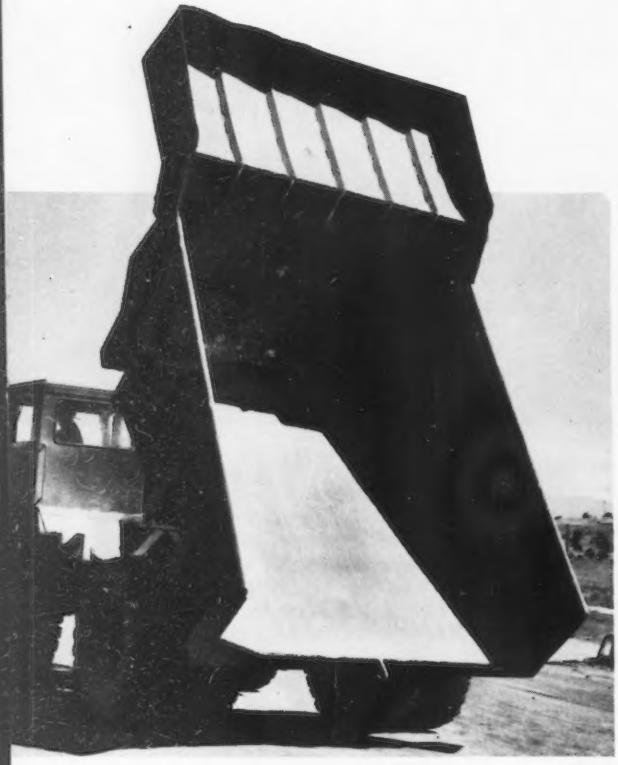
CT-2196-G-1r

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

Proof that LW Haulpak®



This body has been hauling rock for over 4500 HOURS

delivers steady output ...needs little attention

...and look at these tires after 4500 HOURS' USE

An important reason why LeTourneau-Westinghouse Haulpak trucks give you lowest cost per ton-mile is because they need few repairs . . . work longer hours between maintenance stops. Consider the bowl . . .

Shown here is a 32-ton Haulpak body *after 4500 hours of hard service* — carrying 790,000 tons of ore and rocky overburden on hauls up to 10,000 ft*. Look at the super-strength 100,000 psi-yield floor. It's as good as new! Yet, on same operation, trucks with conventional-design bodies required constant repair and maintenance. Now look at the tires on this LW Haulpak . . .

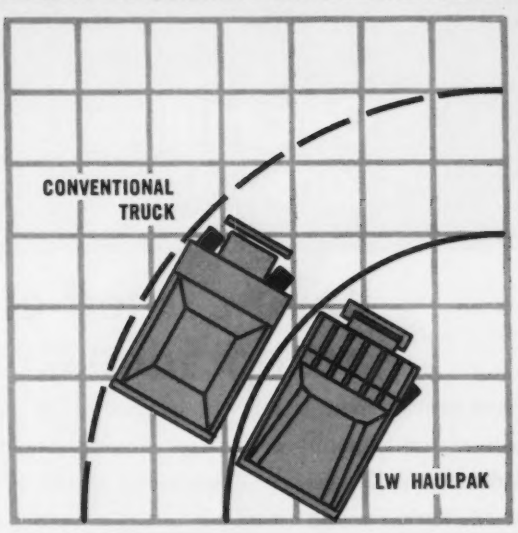
Like the body, these tires have over 4500 hours' use on them. As you can see, they still have plenty of miles left! Owner reports tires on Haulpak last *twice* as long per ton-mile as those on other trucks operating on the same haul. Reason for this welcome added bonus: *Hydrair® suspension.* This exclusive air-hydraulic suspension system also cushions load and road shocks, keeps load riding level. Eliminated are springs, front-axle, and related maintenance.

*Owner's name on request

Here's the 60-ton Haulpak . . . biggest end-dump in the LW line. It carries almost *twice* its own weight in payload. Has 550-hp diesel engine, power-shift transmission with speeds up to 46.6 mph.

More reasons why LW Haulpaks deliver *steady* output and need *little* attention: *Double-reduction axle* eliminates planetary "hot box" inside rear wheels; *Short heavy-duty drive train* has half as many gears as ordinary trucks, needs 15% less hp to turn than other drivetrains; *Dry-type air cleaner* removes up to 99.8% of dust for efficient engine performance; *Bolt-circle wheel mounting* for easy service, less trouble. *Aircraft type multi-disc brakes* offer *four times* more stopping surface than most haulers.

Why not let your LeTourneau-Westinghouse Distributor give you *all* the facts on Haulpak. He'll also be happy to arrange a demonstration. 5 end-dump sizes, 22 to 60 tons. 90-ton bottom-dump also available.



⅓ shorter turn circle

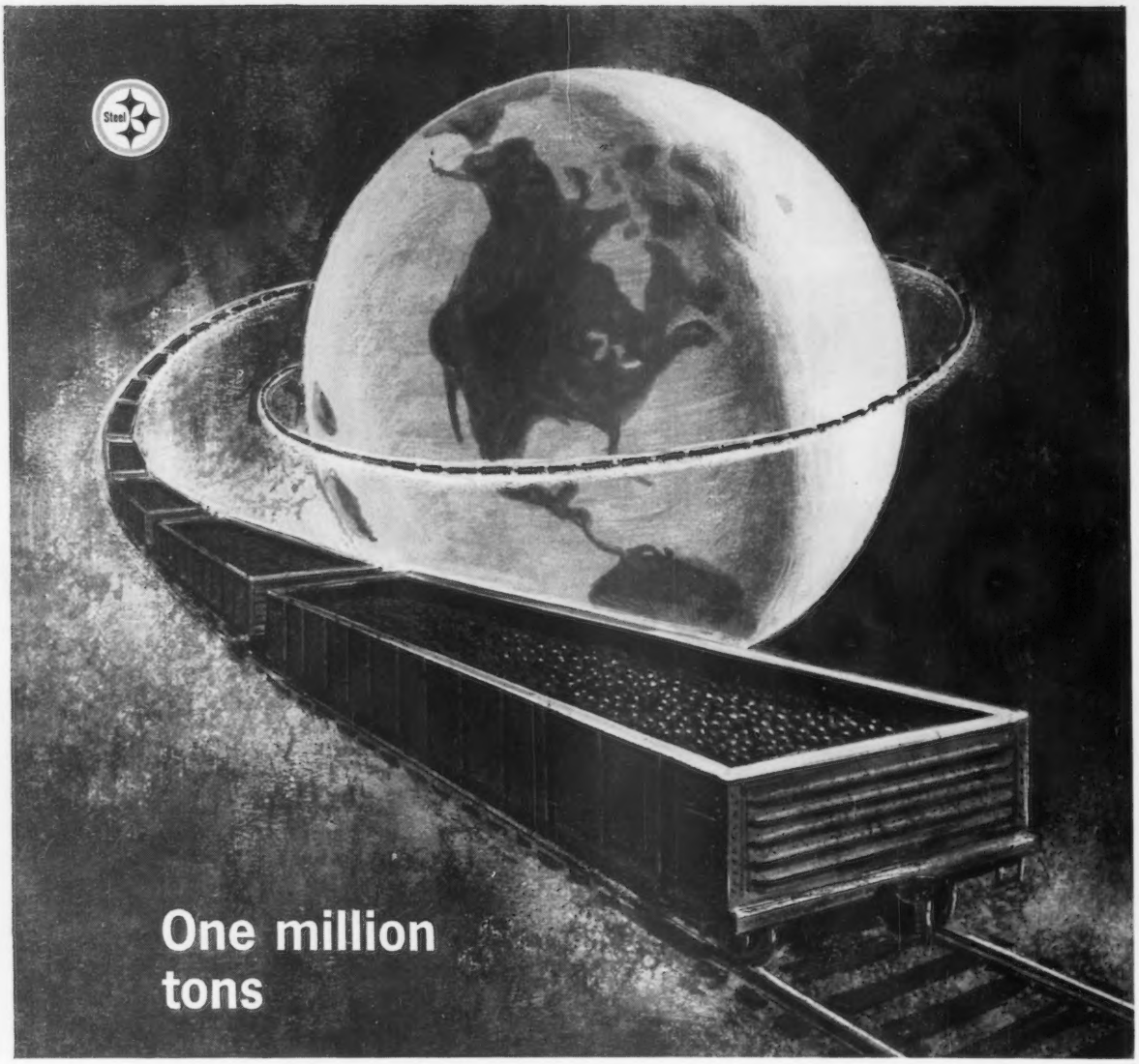
In addition to a smoother ride and increased tire life, Hydrair suspension permits front wheels to turn at a sharp 45° angle . . . *because there are no spring or axle obstructions.* Result: Haulpak turns in ⅓ *less* space than comparable-capacity haulers, and *much shorter* than many smaller rigs. You spot faster at load and dump, complete more cycles per shift!

HP-2424-G-2

LeTOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit



have earned customer acceptance

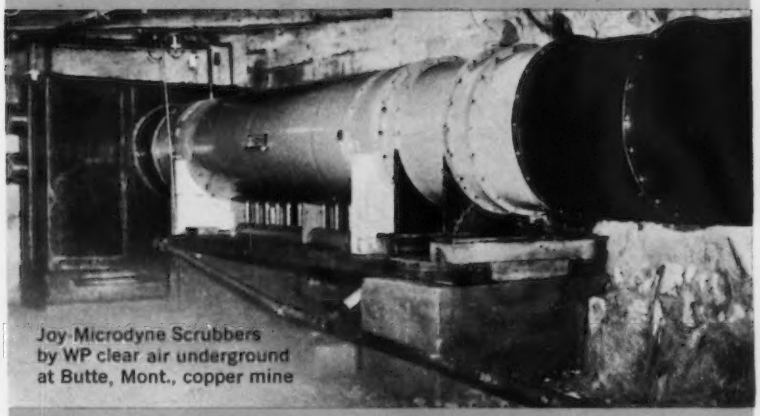
More than a million tons of Sheffield Grinding Balls of all kinds have proved their worth, throughout the world. This record of performance is no accident. It's the result of tight, quality control of alloying, heat-treating and forging — every step of the way. Sheffield Moly-Cop Balls keep their sphericity longer, give a better, more uniform grind, at the lowest possible cost per ton. No wonder Sheffield Grinding Balls are the standard of comparison, around the world. **Sheffield Division, Armco Steel Corporation, Sheffield Station, Kansas City 25, Mo.**

SHEFFIELD
MOLY-COP
Grinding Balls

ARMCO Sheffield Division

Electrostatic Precipitators by WP clean smelter gasses at La Oroya, Peru

Copper smelters in Peru... and miners in Montana...agree:



Joy-Microdyne Scrubbers by WP clear air underground at Butte, Mont., copper mine

When DUST is your problem— CLEAR IT WITH WP*

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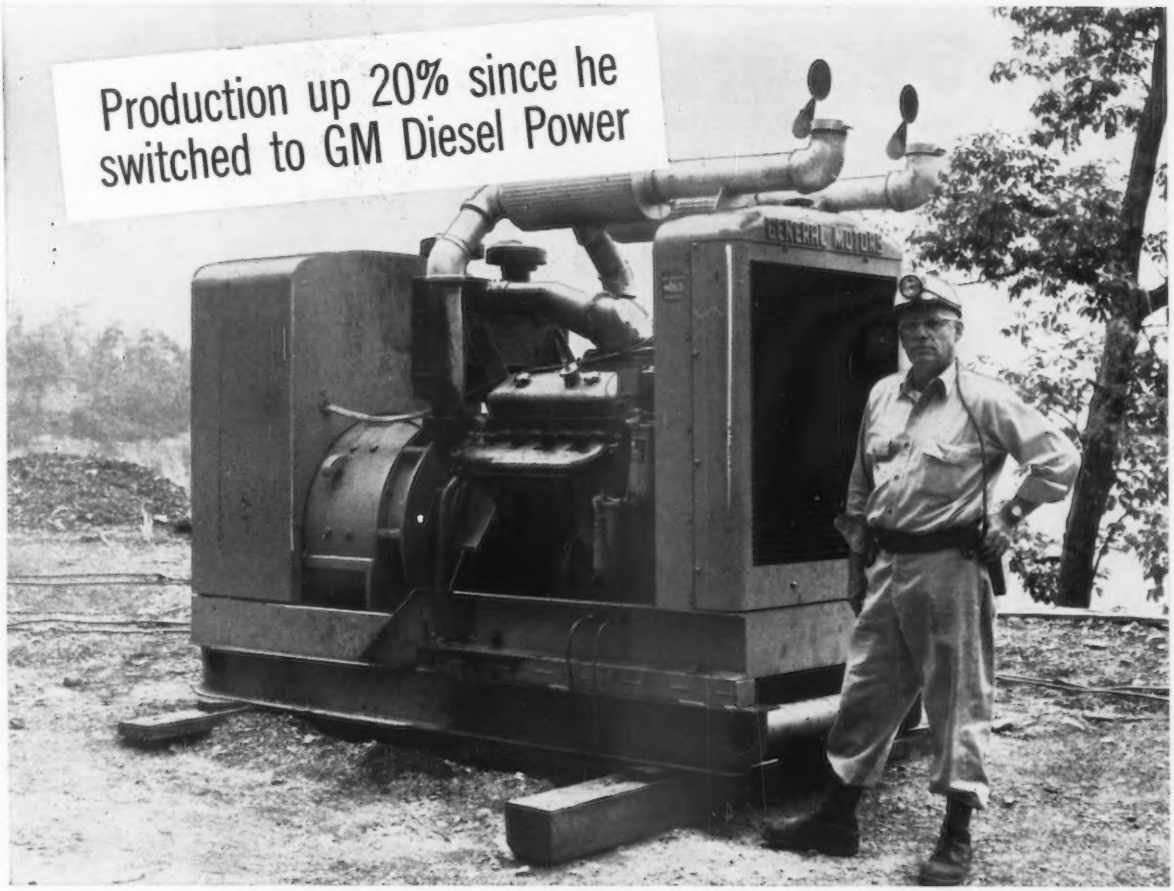

Production up 50 tons per day with no increase in fuel consumption.

Equipment slowdown because of sudden load increases ended—electric-motor overloading eliminated—downtime and equipment repairs cut...

That's what happened at Phillips Coal Company's Reedy Creek Operation in Pineville, W. Va., when they switched from a competitive Diesel to an 8V-71 "Jimmy."

The "8V-71" runs a 150 KW generator—furnishes all the power needed by a #512 hydraulic coal cutting machine, #14BU Joy loader, two 6SC Joy shuttle cars, belt line, chain line, and 5-foot ventilating fan. There's reserve power for additional equipment if it's needed, too.

Reedy Creek Owner-Manager Leonard Phillips says he picked a GM Diesel because of the job other "Jimmys" have done for him since 1954. He operates a Koehring shovel and two auger drills, powered by "4-71" GM Diesels—reports he's averaging four years between engine overhauls.

If you want to make more money from your mine, put a GM Diesel to work for you. See your GM Diesel Distributor for details. He's part of a coast-to-coast network of "engine people" you'll find in the Yellow Pages under "Engines, Diesels."

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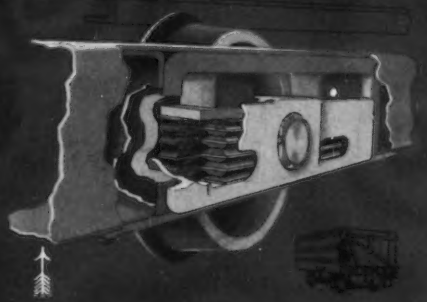
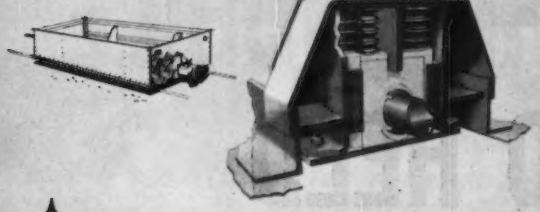
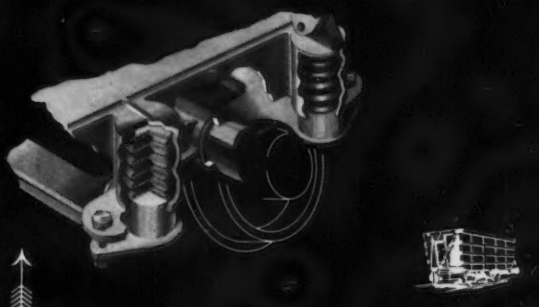
① National MI-245 rubber units, for 4-wheel rotary dump car, minimize vertical oscillation of cars through high absorption characteristics.



② Twin National MI-235 units used on each side of the axle center line and outboard of the wheels.



③ Twin National MI-240 units used on each side and over the axle inboard of the wheels.



④ Twin National MI-240 units, used in narrow body cars, are located in line with wheels to eliminate side overhang.

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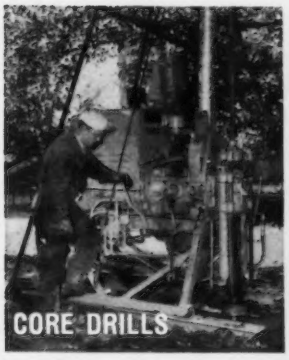
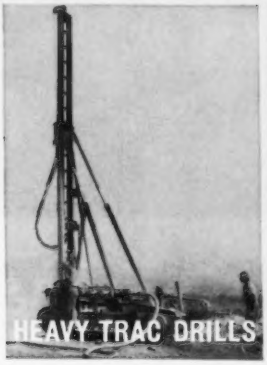
See your Joy representative whenever you have a drilling job to be done. He can give you the right equipment at the right price to keep drilling costs down. For more complete information on the Joy line of drills, write for Bulletin 3331-4. 3331





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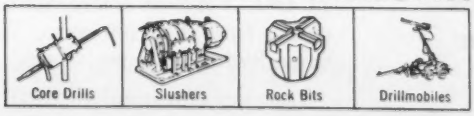

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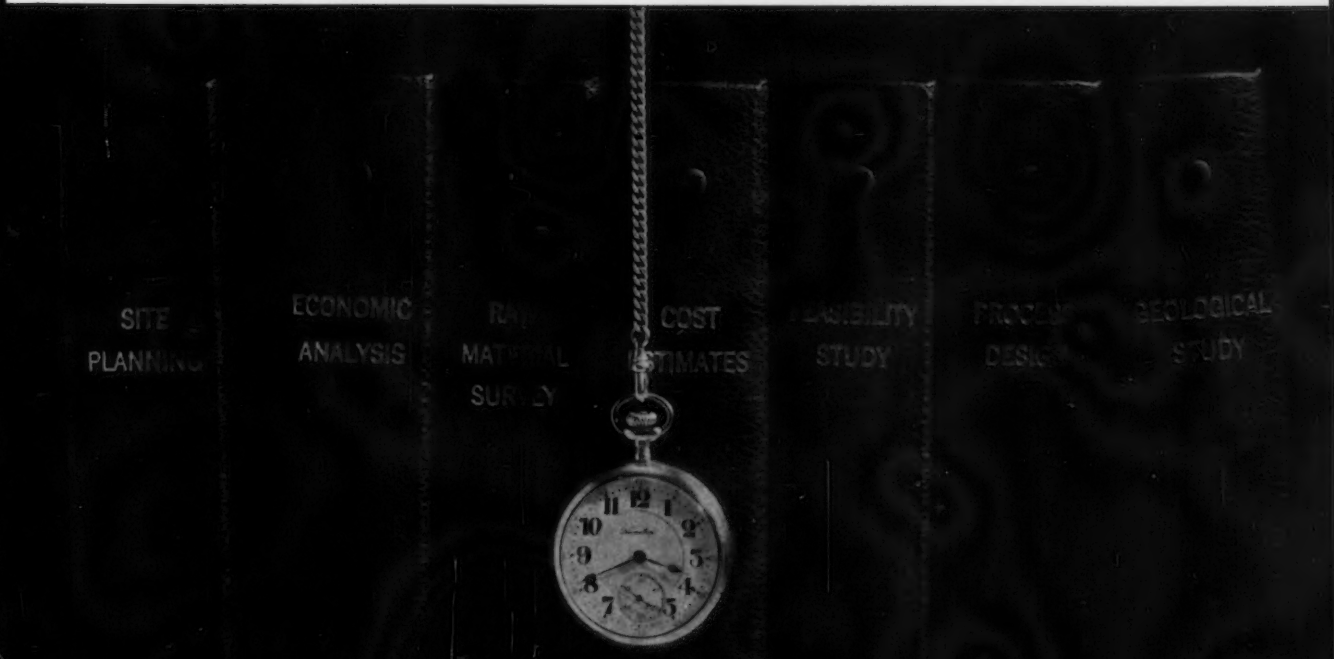

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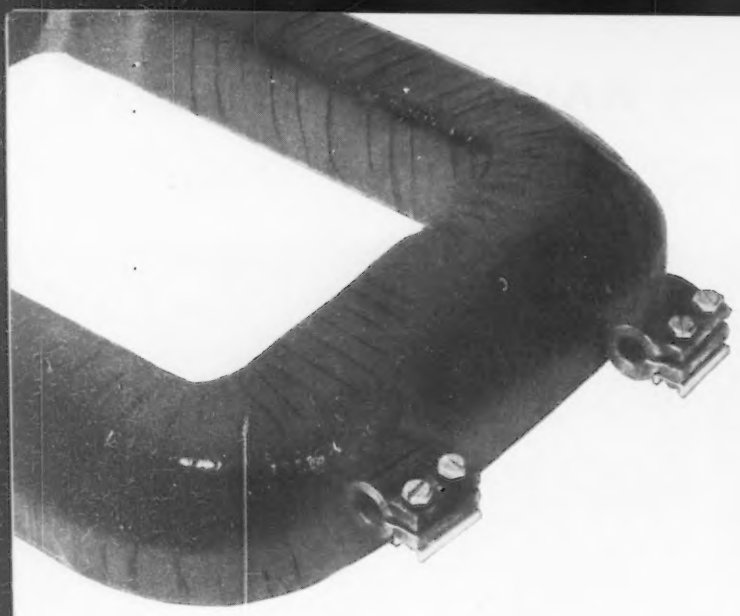

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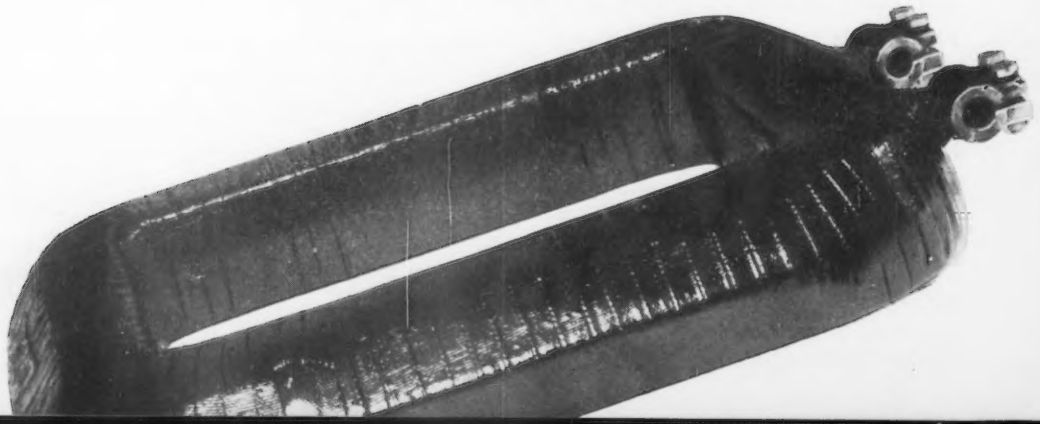

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Thermag and Thermag H: The chemical and physical properties of these hard burned spinel-bonded magnesite-chrome refractories make them particularly well suited for roofs and sidewalls of electric copper melting furnaces.

H-W Periklase and H-W Magnesite: Predominantly periclase (stabilized crystalline magnesia), these refractories are for the strongest basic linings and meet the most severe service requirements. They are fired at an extremely high temperature and are dense, strong and volume-stable at temperatures above those employed in copper furnaces. The unusually high magnesia content and the enhanced physical properties of these brands account for their wide and growing preference.

Metalkase Magnex and Metalkase Magnex XXP: Among basic refractories, the most resistant to severe spalling conditions are Harbison-Walker METALKASE MAGNEX brick. They are furnished in various sizes and shapes and are made in both chemically-bonded and hard-fired refractories of various compositions for use in suspended roofs of smelting and refining furnaces.

METALKASE MAGNEX XXP available in various compositions, standard sizes, suspended arch shapes.

Star—Vega—Vega HP (hot patch): STAR brand is widely regarded as standard for refining furnace bottoms and roofs and is used with excellent results in roofs of reverberatory matte smelting furnaces.

VEGA is the original superduty high temperature silica brick from which greatest benefit is derived in positions where extremely severe conditions prevail.

VEGA HP (hot patch), with only minor changes in composition and cold strength and no appreciable decrease in porosity, density and refractoriness, possesses the superior property of spalling resistance.

Calamo 200 (anode mold wash): This alumina-silica pulverized refractory best meets the requirement of the anode mold wash.

Other Harbison-Walker accessories for pouring molten copper include Duro brand launder shapes and funnels, furnished in several classes.

FOR ALUMINUM FURNACES

Refractories which are best suited for use in aluminum melting and holding furnaces possess properties which meet various specific requirements. In some furnaces the refractories in the bottoms are subjected to severe impact and abrasion. In the production of various alloys to meet certain rigid specifications, the refractories used must be such that any contamination, such as silicon pick-up, is avoided. High resistance to wetting and penetration by molten metal is paramount.

Coral BP and Coral: These 85% alumina brick, produced in complementary compositions, possess unusual physical properties which are required for aluminum melting furnace bottoms and lower sidewalls.

Both of these refractories resist wetting and penetration by aluminum and its various alloys, are highly resistant to chemical reaction, are exceptionally strong and withstand severe impact and abrasion.

Korundal: This 90% alumina refractory made in several modifications is particularly adapted for various specific needs for bottoms and lower sidewalls.

H-W Silicon Carbide Refractories: HARBIDE silicon carbide brick possesses some measurably enhanced physical properties of major importance. It is unusually resistant to oxidation and wetting by various molten alloys and can be used to advantage in certain furnace positions.

Alamo: Along with other Harbison-Walker superduty fireclay brick brands, ALAMO is favored for upper walls and roofs. Harbison-Walker products for aluminum furnaces comprise additional brands of high-alumina and high-duty fireclay brick which possess the properties needed for best performance.

Bonding Mortars: CORALBOND is a unique phosphate-bonded 85% alumina mortar developed specifically for use in aluminum melting furnaces. It is exceedingly resistant to penetration, and in joints between the high-alumina brick it adds tremendously to the strength of the structure.

HARWACO BOND (diaspore base), THERMOLITH (chrome base) and KORUNDAL BONDING MORTAR (stabilized alumina base), air-setting high temperature bonding mortars have unusually high strength for the temperature range of their use. While these may be used interchangeably for laying the various types of brick, each provides special benefits for particular applications.

H-W Monolithic Materials: KORUNDAL RAMMING MIX . . . H-W HARCHROME CASTABLE . . . H-W EXTRA STRENGTH CASTABLE . . . H-W PLASTIC FIREBRICK . . . among the full complement of Harbison-Walker monolithic refractories are especially adapted for aluminum furnace requirements. They are favored in this industry because of the pronounced properties of volume stability, low thermal expansion and high resistance to both penetration and abrasion.

For Other Non-Ferrous Furnaces

Service conditions in furnaces employed in the numerous non-ferrous metallurgical processes vary widely and the refractories must meet highly specialized requirements. Proper refractory selection frequently governs the degree of success of the processes employed.

Harbison-Walker products comprise all the different types and classes of refractories needed for these metallurgical processes, such as for the reduction and refining of nickel, lead, zinc, tin and other metals. Also included are refractories which serve best in metal chloride furnaces for making titanium and zirconium chlorides and in production of metallic sodium and magnesium.

Still other Harbison-Walker refractories used in non-ferrous furnaces overlap in their large-tonnage usage in the steel industry. These include leading basic refractories for oxygen steel furnaces and for open hearth steel furnaces.

Write Harbison-Walker's Technical Sales Department for further product details or assistance in the Selection and Application of Refractories for your specific application.

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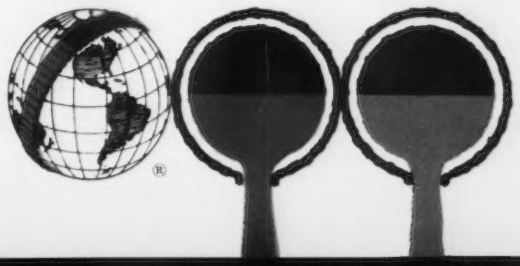

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Mack trucks on your jobs will give you the advantage of lowest cost of operation plus undivided responsibility for full satisfaction. Your nearest Mack branch or distributor will be glad to suggest the exact model to handle your jobs with utmost dependability and efficiency. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

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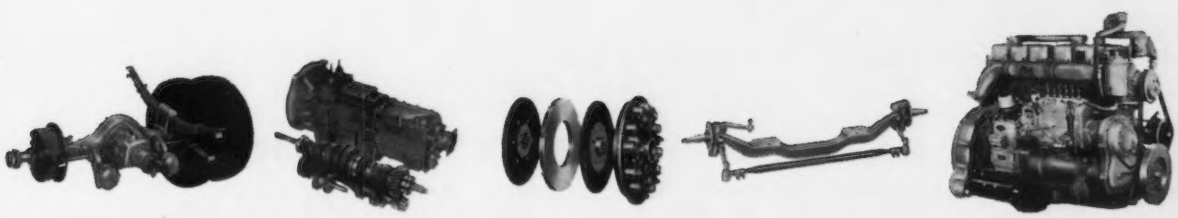

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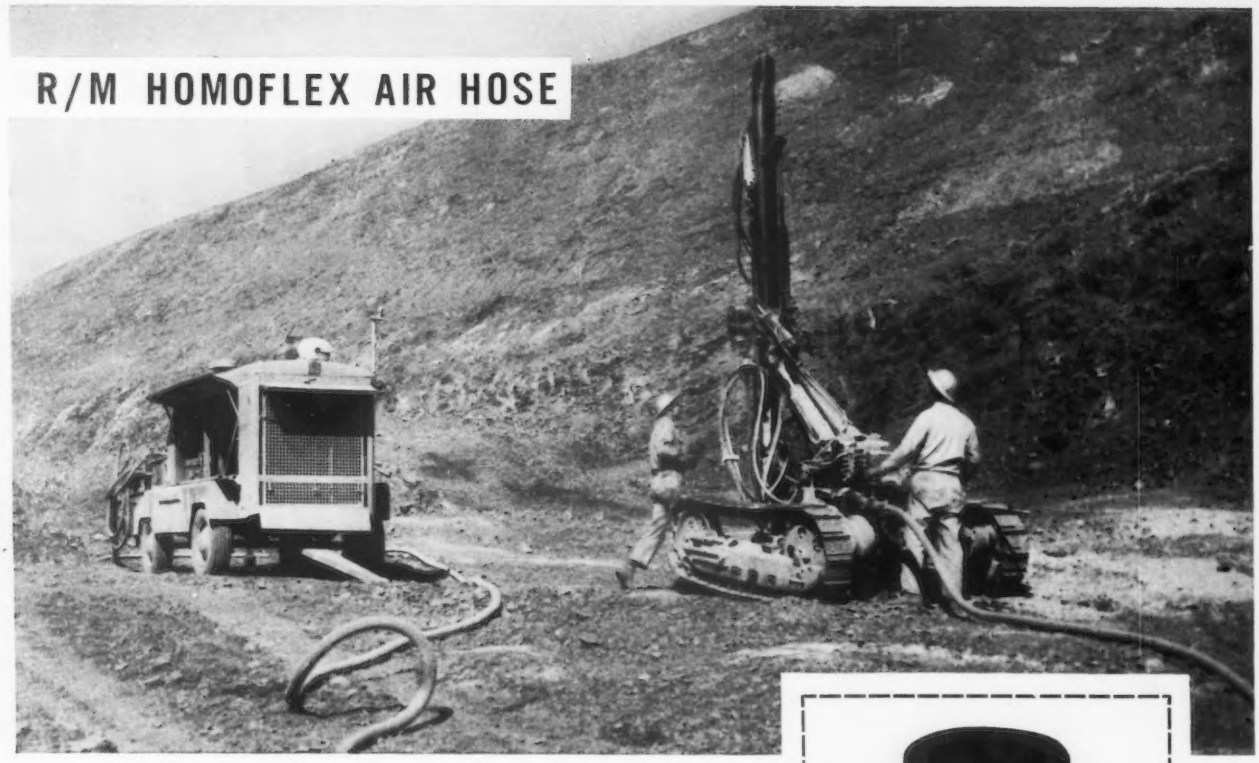

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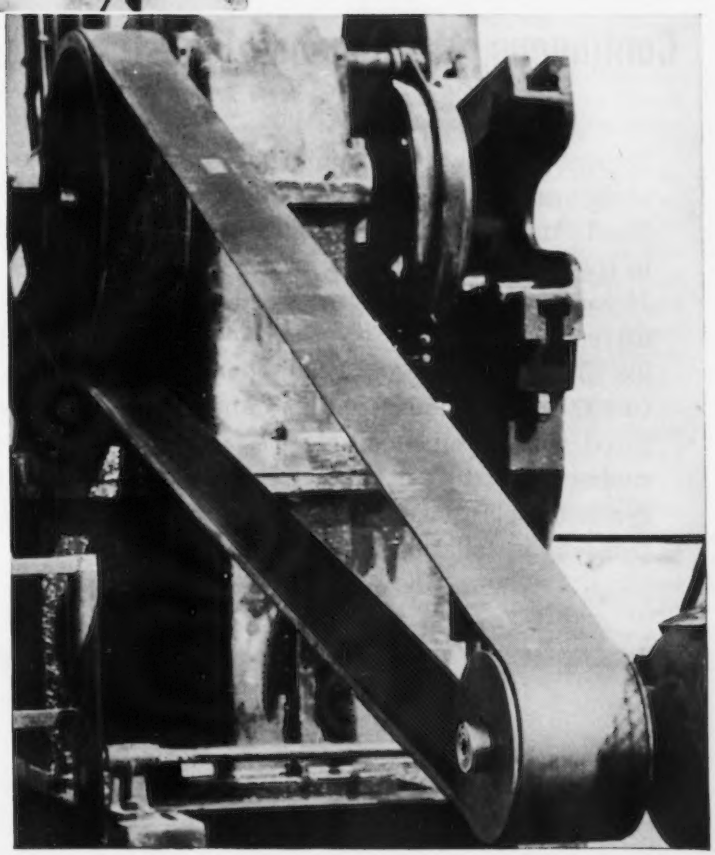
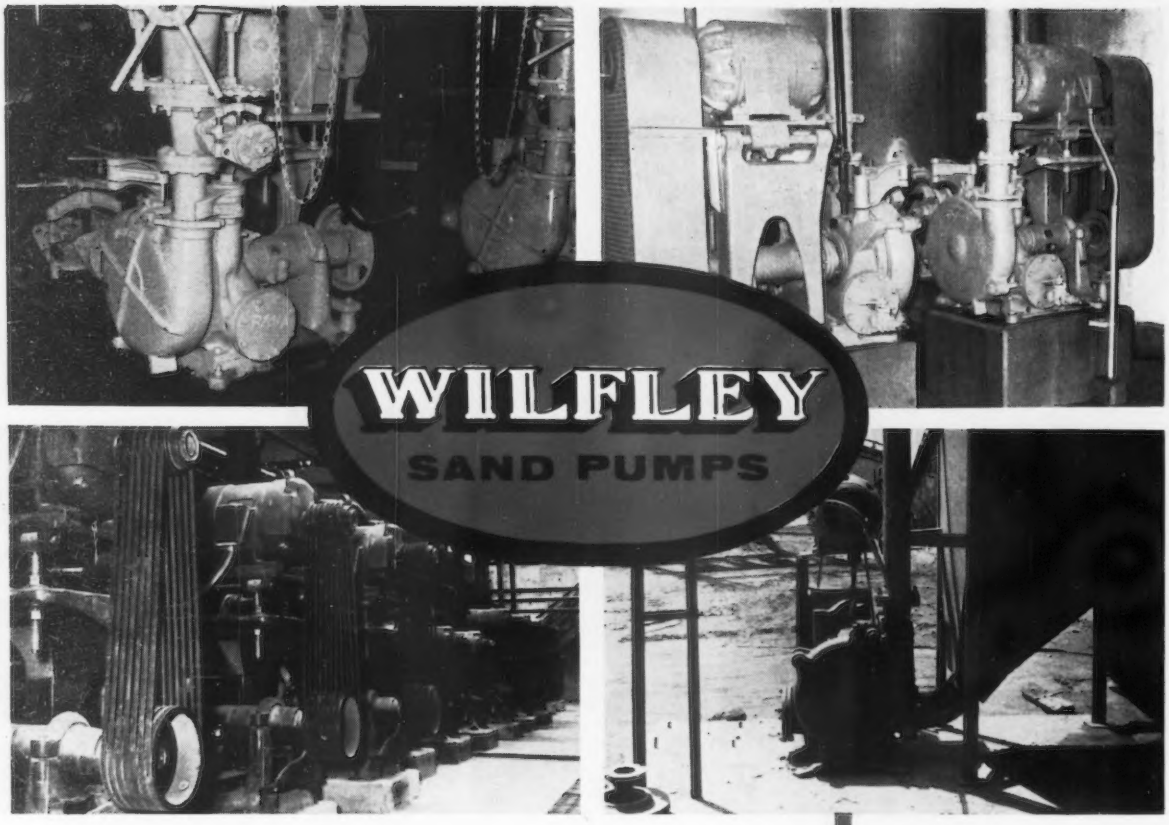
RM131





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ENGINEERING AND MINING JOURNAL

JUNE 1961

May Hearings Spell Trouble for Gold

TWO CONGRESSIONAL HEARINGS scheduled for May will test the power of our industry and its friends in government to withstand new assaults upon the domestic gold mining industry. First there is the hearing of the House Banking Subcommittee, headed by Abraham Multer (Dem. N.Y.), on H.R.6900 which would scrap the 25% gold backing now required for currency and banking reserves. The law ties up about $11-billion of the Government's total gold stocks worth $17.4-billion. Pre-hearing comment in the WALL STREET JOURNAL and AMERICAN MINING CONGRESS BULLETINS indicates that Secretary of Treasury Dillon will endorse the proposed legislation.

Chairman Multer said, "The Subcommittee will also consider whether the gold cover requirement (25%) could undermine the dollar in event of a real crisis in our international balance of payments. On the face of it, it would seem that the world confidence in the dollar could be more easily maintained if it were made perfectly clear by statute that our entire gold stock (now $17.4-billion) is available to meet liquid dollar holdings of foreign countries (now about $18.5-billion). There is of course no prospect of these foreign dollar holdings being presented for payment all at once."

Multer continued, "H.R.6900 would make it crystal clear as the President declared in his Feb. 6 message to Congress on our balance of payments 'The full strength of our gold stocks and other international reserves stands behind the value of the dollar for use if needed.' "

From these remarks we can conclude (1) That the Administration, including the President and Cabinet officers, does not share the belief of the mining industry that statutory backing of gold is necessary to discipline the Government's spending habits. (2) If this bill passes, the U.S. Government will have walked completely away from its pseudo-dependence upon gold for the settlement of international balances. (3) Having done that, the Government will have nullified its needs to support the domestic gold mining industry through incentives or other plans.

The American Mining Congress announced that it would have a witness to appear in opposition to H.R.6900.

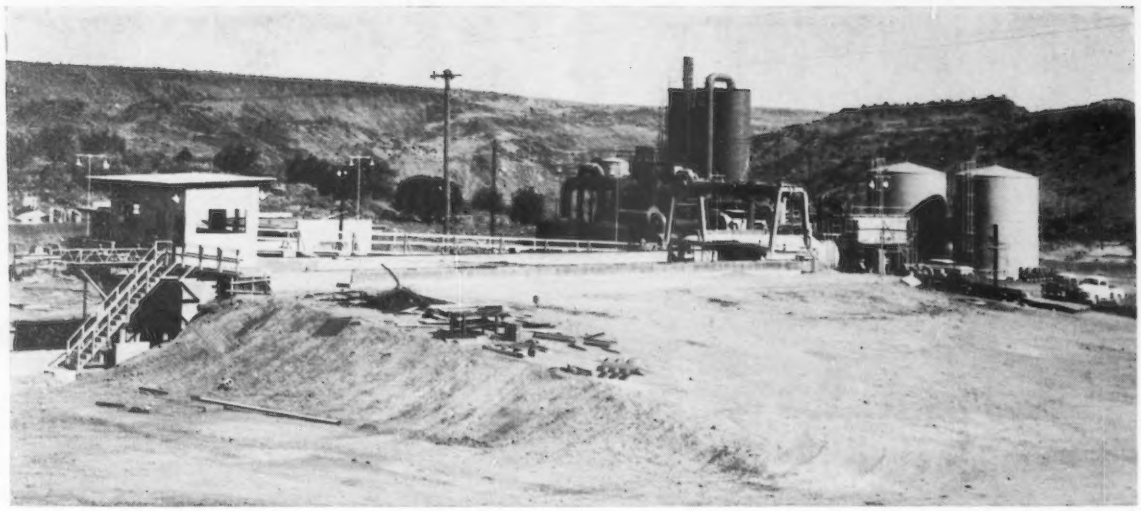
The second threat to gold comes in the form of testimony by the U.S. Bureau of Mines, Division of Minerals, presented before hearings of the House Interior Mines and Mining Subcommittee which aired bills proposing various subsidies to stimulate and reopen domestic gold mines. The report of the Interior Department on the proposed subsidy bills said, "The Executive Branch is opposed to the enactment of any legislation that would establish or imply a second price for gold, different from the $35 per ounce now in effect. The report added "The payment of incentives of the sort proposed by the bill would result in a situation that gold costing the Government $70 an ounce would be offered at $35 an ounce to foreign monetary authorities and American industrial users of gold. . . . Although the Department of Interior recognizes that the bill would be beneficial to gold miners, the Executive Branch has concluded, in view of the paramount national interest in the monetary function of gold, that the enactment of this legislation would not be desirable."

So there we have it. In one hearing, voicing Administration policy, we learn that gold is no longer necessary to back currency. In another hearing, again quoting Administration opinion, we learn that we can't have a subsidy because of the "paramount national interest in the monetary function of gold."

All of this indicates that a certain amount of muddled policy concerning the importance of gold needs to be clarified in Washington. Secondly, if the writers of bills in Congress can't incorporate provisions to earmark subsidized gold so that it will not be sold below cost, we've reached an all-time low in legislative imagination and aptitude. If gold continues to be monetized on a 4-for-1 basis, and if the volume of currency and banking reserves continues to grow under the double pressure of population growth and inflation, there should be no reason why $70 domestic new gold couldn't be consigned permanently to swell the $11-billion minimum Government holdings that now help to maintain world faith in the dollar.

Repeating observations made in two previous editorials, it appears that more than ever, we now need a Department of Mineral Resources in Washington, with a Secretary of cabinet status who will represent the best interests of the mining industry and have the courage to oppose Administration policy which is detrimental to domestic mining and processing.

As we go to press, news from our Washington correspondent (p20) is that the House Banking Subcommittee hearings on H.R.6900 have been postponed indefinitely. Reason—because so many people have requested permission to testify against the bill. As we said in the first paragraph, the power of the mining industry and its friends in Government is being tested—perhaps it's stronger than we think.



BAGDAD COPPER CORP.'S new cement copper leaching plant, including an auxiliary sulphuric acid contact unit, went onstream early in April. Initial production figures raise capacity by 20 tons of copper a day from low-grade oxide ore.

Cement Copper Begins at Bagdad

JOHN B. HUTTL

FIRST month's production results from Bagdad Copper Corp.'s new cement copper leaching unit, which went onstream at the Bagdad, Ariz., plant in early April, show some 20 tons of cement copper daily added to the sulphide ore pit output.

The new $2-million plant including an auxiliary sulphuric acid contact facility, results from an extensive examination period. Bagdad carried out investigations and pilot plant test work over the past 15 years, trying to fit a leach process into its operations, before allowing the go-ahead on plant construction. The purpose of the project: to recover copper by normal leach-precipitation from (1) low-grade oxide stockpiles and from (2) the oxide ore overburden, which had been stripped away to reach the richer sulphide deposits for the flotation concentrator.

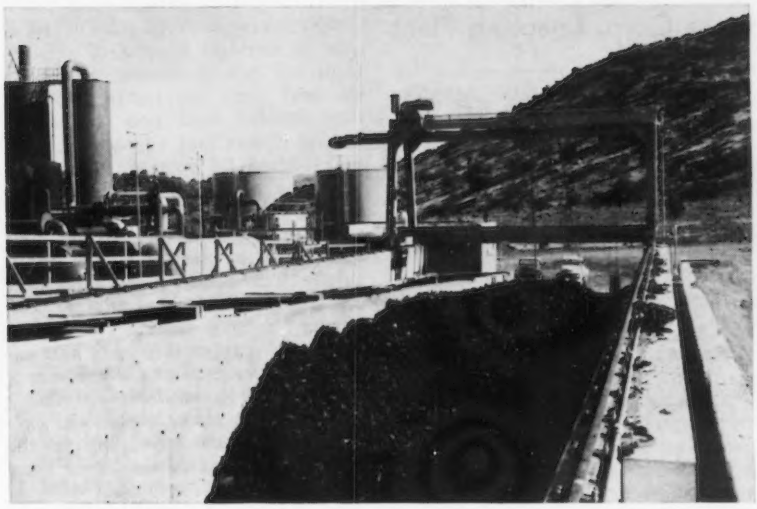
Actual construction work started early last August and both the leaching unit and the sulphuric acid plant—producing 200 tpd of 93-98% Baume acid—were ready for production by the end of March. Fisher Contracting of Phoenix engineered and constructed the project in consultation with Bagdad's engineering department.

Two large low-grade oxide ore stockpiles, in neighboring canyons, are available for cement copper leaching: (1) the Alum Creek dump currently being leached; and (2) the Mineral Creek dump now held in reserve. The top surface of the Alum Creek dump is divided into square pools, each measuring 100x100 ft, with the common bottom of a panel of pools sloping at from 1- to 2% grade. Leveling the leach area and building embankments and partitions with overflows is done with a tractor equipped with a dozer blade. Iron precipitations that eventually may form on the floor of each pool will be bladed off (after drying) by a tractor equipped with a special blade to restore free seepage of water into the dump proper. When such drying occurs, the plugged pool is cut out of the circuit and leach water is directed to the succeeding pools.

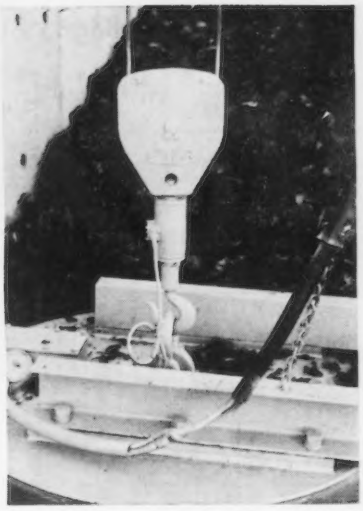
Plant solution flow is scheduled to be maintained at 4800 gpm. The acidic water flows by gravity through a 7500-ft, 14-in. plastic-lined steel pipe from a weir box at the foot of two settling ponds, each capable of holding 1-million gal of barren solution from the precipitation plant, to the leaching area. Make-up water from wells and sulphuric acid is added at the weir. The leach solution contains about ¾% of sulphuric acid. Solution losses occur, chiefly because of evaporation on the order of 30% for each recirculation. Pregnant solution flows from the bottom of the dump to a dam with a pump station and is pumped to a 1-million gal plastic-lined earth surge pond by two U. S. vertical turbine pumps, which are driven by 400-hp motors. These are automatically controlled, with one unit in operation when solution flow from dump is normal and two units in operation when load rises above normal. The pipeline connecting the pump station and surge pond is made up of sections of 14-in. plastic-lined pipe. Total length is 4500 ft. The amount of pregnant solution containing an average of 1 gpl copper, normally handled is 3350 gpm. From the surge pond, pregnant solution is transferred by gravity via a 16-in. stainless steel-transite pipeline (end sections are stainless steel and center part transite) to a concrete weir box at the head of the precipitation cells.

In designing the precipitation plant, no efforts have been spared to make it an efficient and low-cost operation. Foremost among these are: (1) use of deep cells to provide optimum contact between pregnant solution flowing down one cell and rising through the succeeding cell and the detinned can load; (2) semi-automatic handling of cans from the stockpile area to precipitation cells; and (3) direct pumping of cement copper, produced and stored in hoppers below cell units, to a sump serving a Bird centrifuge. This last point eliminates the conventional time-consuming method of washing cement copper from cans through the grids onto drying pads or cells by a stream of high-pressure water.

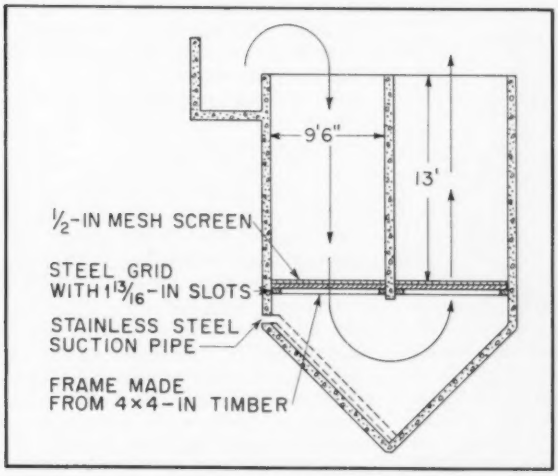
The precipitation plan proper, heart of the operation, consists of 10 units, each of two cells. Total area occupied by the plant measures 22x122 ft. The dense concrete cells measure 10x9½



CONCRETE STORAGE BIN holding detinned cans for the 10 two-cell precipitation units is serviced by steel gantry crane with two Schrader magnets.



LOAD CELL IN 48-in.-dia Schrader gives recording of total weight moved.



CROSS-SECTION OF a precipitation unit shows the dimensions of its two cells. Cement copper is pumped through suction pipe.

THE NEARBY ALUM CREEK dump, now under leach, is one area which supplies Bagdad with the copper oxide ore.

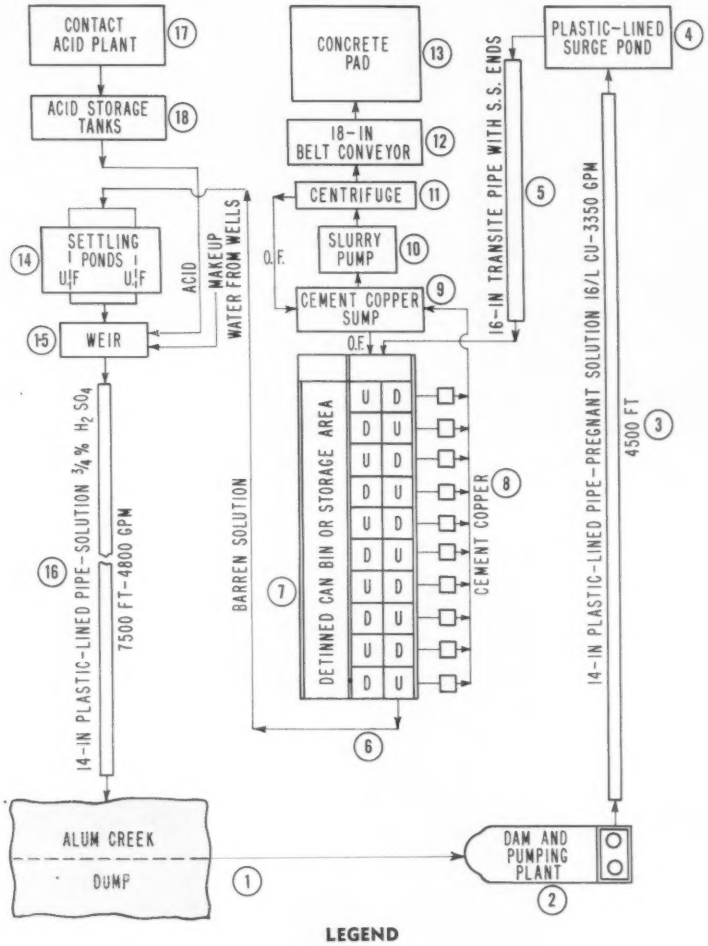
ft in cross-section and 13 ft from the top of the grids supporting the load of detinned cans to the top of the cell. Each two-cell unit has a common hopper bottom which collects the cement copper falling through the grids. These units, resting on a frame structure made from 4x4-in. timber and attached to the cell walls, are made up of a screen with ½-in. openings on top and a steel grate with 1 13/16x4-in. slots at the bottom. The pregnant solution from the feed weir travels about 260 ft (down one cell and up the other) at 3.6% grade. Provision is made to change the left-right flow of the solution to right-left flow whenever this is desired.

Cement copper, collected in each cell unit hopper, is pumped by 10 Worthington 40-gpm slurry pumps to a concrete sump for dewatering. From there, the underflow is pumped by another similar 40-gpm slurry pump to a Bird centrifuge which discharges treated material onto an 18-in. belt conveyor leading to a concrete pad. The dried cement copper stored here is loaded by a Payloader unit into trucks for shipment to the smelter via the Hillside rail point. Overflow from the centrifuge returns to the dewatering sump mentioned, while the sump overflow itself goes to the head of the precipitation plant.

The detinned cans, the principal precipitating material, are stored in a concrete bin that, with one end open, runs the entire length of the precipitation cell assembly. Transfer and cell loading equipment consist of a steel gantry crane with two Schrader 48-in.-dia magnets spanning the cell and can storage area. The magnets have built-in load cells which report weight loaded into cell to a totalizing unit, giving the operator a sum total of weight of cans fed to the plant at all times. Daily consumption of detinned cans currently is estimated at about 32 tons which, at a production rate of 20 tons of cement copper, represents an iron-copper ratio of 1.6:1.

Removing cans from storage and loading them into individual cells is a semi-automatic operation carried on from a pushbutton station at the head of the precipitation plant. While positioning the crane along the center line of a two-cell unit, the movement of the magnets and the cutting of current—to drop the magnet load at any point in the cell system desired—are

Flowsheet—New Bagdad Copper Corp. Leaching Plant



LEGEND

1. Alum Creek Dump
2. Dam with pump station employing two 400-hp vertical turbine pumps
3. 4500-ft long plastic-lined pipe line handling pregnant solution
4. 1-million gal plastic-lined earth surge pond for pregnant solution
5. 16-in Transite pipe line with stainless-steel ends
6. 20-cell precipitation plant
7. Detinned can bin or storage area
8. Ten 40-gpm slurry pumps for pumping cement copper from cells to dewatering sump
9. Cement copper dewatering sump
10. 40-gpm slurry pump for pumping underflow from cement copper dewatering sump Bird centrifuge
11. Bird centrifuge
12. 18-in. belt conveyor
13. Concrete pad for stockpiling finished cement copper
14. Two barren solution settling ponds. Capacity 1-million gal each
15. Weir
16. 7500-ft long plastic-lined pipe line directing leach solution to Alum Creek dump
17. 200-tpd sulphuric acid contact plant
18. Sulphuric acid storage tanks

directed by the station's pushbutton controls.

All barren solution, flowing from the last two precipitation cells, is directed to the two 1-million gal settling ponds mentioned previously, with the underflow going to the weir box at the head of the 14-in. pipeline leading to the Alum Creek dump. All makeup water and acid added to the weir box is metered. Stainless steel or plastic equipment and shielding are used at critical points in the plant circuit to reduce damage from corrosion to a minimum.

Design and operation of the 200-tpd sulphuric acid contact plant supplying the leach solution follows more or less conventional practice. Plant layout and equipment used are shown in the general plant flowsheet. Sulphur is brought in a molten state to the plant in special trucks from the rail point at Hillside some 20 miles distant, where a steam plant is available to facilitate transfer of sulphur from rail cars to waiting trucks. At the acid plant, the trucks discharge their molten load into an underground charge tank capable of holding 200 tons of sulphur. Above this tank is a concrete pad for storing a reserve tonnage of solidified sulphur.

The contact process is too well known to be described in detail. Briefly, it involves passing a purified, dry sulphur dioxide gas mixture containing 7 to 10% sulphur dioxide and 11 to 14% oxygen through a heat exchanger, a reactor unit containing a platinum or vanadium pentoxide catalyst, oleum tower, cooler, and storage. Temperature prevailing in the first part of the reactor varies from 500- to 600° C and from 400- to 450° C in the second part of the reactor. Contact time varies with design but is generally 2 to 4 sec. Proper choice of acid concentrations, tower temperature, and blending of the products allows production of various concentrations of acid. Arrangement of the catalyst within the reactor and type of heat exchangers used vary from one plant to another. Reaction is as follows:

$$2SO_2 + O_2 \longrightarrow 2SO_3$$
$$SO_3 + H_2O \longrightarrow H_2SO_4$$

At the Bagdad plant, plant operations start at the sulphur burner, operating in conjunction with a waste heat boiler which furnishes heat for the process units following and steam for the turbine-driven fans. Exhaust steam from these units and others goes to a condenser, with resultant condensate returning to the boiler water feed. Equipment units following the sulphur burner include a heat exchanger; four-part reactor using vanadium pentoxide as a catalyst; SO_3 cooling tower, adsorption tower followed by externally cooled coils; drying tower followed by externally cooled coils; acid pumps; acid storage tanks; and water cooling tower.

Auxiliary buildings situated alongside the plant include a well-equipped laboratory; change room; repair and materials storage room; and office. The plant described is operated on an around-the-clock basis, employing some 16 men, including supervisory personnel.

David C. Lincoln is president of Bagdad Copper Corp.; George W. Colville, executive vice president and general manager; and R. C. Bogart, assistant general manager. Officials of Fisher Contracting Co. responsible for construction of the leaching and acid plants include Warren Hunter, vice president; Ervin C. Harney, chief engineer, Industrial Division, and project manager; and W. R. Heinke, project superintendent.

How to Get the Longest Life From Your Drilling Equipment

CURT DAHLIN

BY PROPERLY BALANCING the physical properties of the steel rod, tungsten carbide, rock drills and rock, longer life can be obtained from drilling equipment. Like a chain, the weakest link determines the strength, and consequently the life of the system.

To properly balance the equipment, one must analyze the drilling conditions: wet or dry drilling, properties of the rock, size of the rock drill and care and handling of equipment. By relating all factors to each other, the most efficient combination of equipment can be determined.

The Sandvik Steel Works has been testing drilling equipment in one of their mines since 1945. Here, approximately 600,000 ft are drilled annually with integral steel, extension steel and detachable bits for testing purposes alone. Furthermore, numerous field tests are conducted by special personnel with different customers all over the world, and, as all testing is conducted in close cooperation with Atlas Copco, a rapid development of both drill steel equipment and rock drills has been possible.

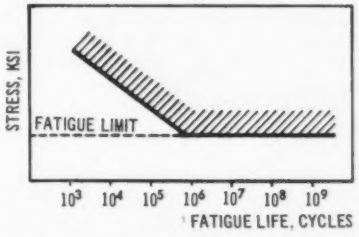
The tests have given many interesting results, many of which are covered in this article. The conclusions arrived at apply in the first place to integral drill steel but are generally applicable for other drill steel products.

Drill Steel Life Factors

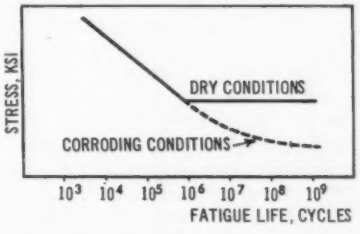
The size of tensile and compressive stresses in percussive drill rods depends mainly on the impact velocity, size and design of the piston, and the properties of the rock. In addition, bending stresses are caused either by oblique blows on the striking surface due to worn chucks or by a drill steel being bent during drilling. During dry drilling, the bit end can become quite hot, which may reduce steel life. In wet drilling, heavy corrosion greatly reduces steel life, unless special preventive steps are taken.

Mr. Dahlin is with the Sandvik Steel Works Co. Ltd., Sandviken, Sweden. This article is abstracted from a paper entitled "Factors Influencing the Life of Drill Steel Equipment" given at the International Symposium on Mining Research, Rolla, Mo.

These bending, tensile and compressive stresses can cause fatigue failures. The number of impact stresses is directly proportional to the actual time of drilling or, in other words, the number of blows delivered by the rock drill. Whether the stresses lead to fatigue failures or not depends on the stress level and on how difficult the corroding conditions are.



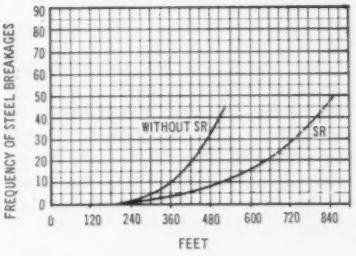
The fatigue diagram above is based on laboratory tests with the drill steels under dry conditions, in which case there is a fixed fatigue limit. Below the fatigue limit, the steel can be stressed any number of cycles without fracture. If the drill steel is simultaneously exposed to stresses and corrosion, the fatigue diagram presents an altogether different appearance (below).



In this case there is no longer any fixed fatigue limit.

The fatigue strength of the drill steel is, of course, not only influenced by corrosion but also by the hardness of the steel, the surface finish, and the design of the drill steel. Earlier, about 80% of all steel fractures started from the inside of the flushing hole in the soft zone next to the shank end, because the area was simultaneously exposed both to stresses and corrosion.

Comprehensive research resulted in the so-called SR-treatment (spiral rolled), by which the soft zone fractures have been eliminated (below).



The fractures which occurred after this improvement started from the outside of the rod, but only after a considerably higher footage. Shot peening was found to be the most suitable surface treatment of increasing fatigue strength of the rods. By combining shot peening and SR-treatment, the life of the drill steel has been considerably increased.

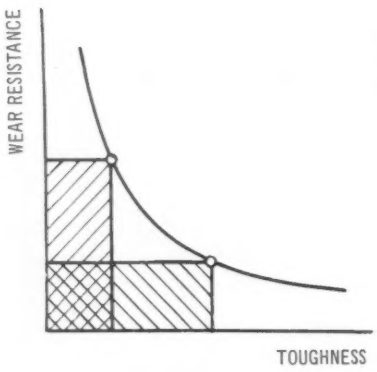
For a certain steel quality, drill steel life is determined by the stress level at which the steel is working. The stress level, in turn, is determined by the drilling conditions, i.e., above all by the rock drill itself, the properties of the rock and the handling of the drill steel. As a result of the development of steels with higher fatigue strength, stronger and more efficient rock drills can be used.

TC Insert Life Factors

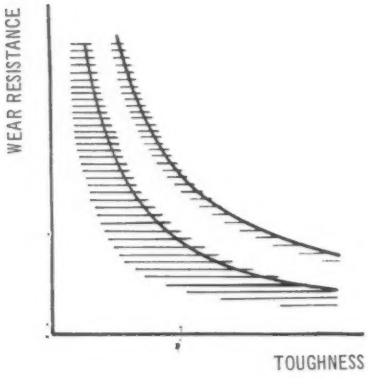
Improvements in carbide insert life have been obtained partly by increasing the insert dimensions and partly by considerably improving material quality. The inserts mainly contain two components: tungsten carbide, which is the wear-resistant part; and cobalt, which is the tough component. Wear resistance is increased by decreasing the grain size of the tungsten and/or the cobalt content. The toughness, on the other hand, is increased by increasing the grain size and/or the cobalt content.

Wear resistance and toughness cannot be increased at the same time. One must balance the cobalt content and the grain size in such a way that the best possible properties are ob-

tained. This is, in a simple way, illustrated by the diagram below.



By selecting the most suitable structure and by a careful manufacture of the cemented tungsten carbide, using very pure components, avoiding graphite, porosities and brittle components, the wear resistance-toughness curve can be moved to a higher quality level (see below).

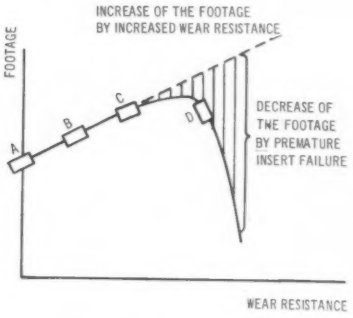


Thus, it has been possible to obtain a higher wear resistance at unchanged toughness or a better toughness with the same wear resistance. Simultaneously with this increase in the quality level, the deviation (hatched area) has been decreased.

As toughness and wear resistance are interdependent, the carbide must be selected in such a way that the degree of toughness is high enough but not too high. The insert life will increase with increased wear resistance (decreased toughness) to a certain degree. If this degree is exceeded, the number of early failures will increase due to the carbide being too brittle, as is shown in the top diagram, center column of this page.

Because drilling conditions vary considerably within one working area, the carbide grade must be so selected that the risk of failures is at a minimum. By using an even quality material, the grade can be selected close to the critical limits for insert breakage.

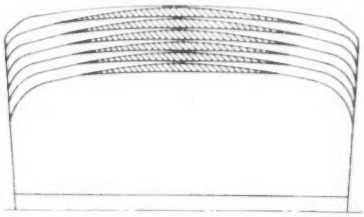
With too powerful rock drills and when drilling is executed in very hard rock, e.g., fine-grained hematites, the insert may be crushed immediately. In this case, not only insert toughness but also the rock drill size must be



matched with the rock properties. By doing this, one may drill under severe drilling conditions without premature failures.

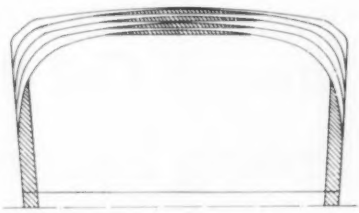
Types of Insert Wear

Inserts are mainly worn either on the heights or on the gage. When the wear is frontal, there is, practically speaking, a reduction only of the insert height without much reduction of the gage. A considerable part of the height reduction is due to the quantity of carbide which is ground away at the regrinds (hatched area on figure below).



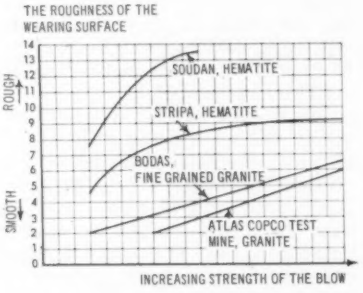
Gage wear, on the other hand, is a wearing down of the insert corners. When the wear has reached the base of the insert (fully developed so-called reverse taper), the gage wear increases rapidly. Under most conditions, the wear cannot be allowed to approach this point since the insert will then fracture. To prevent this, the clearance of the insert must be restored by grinding on the gage at suitable intervals (hatched area on the top diagram, right column of this page, represents loss of carbide at edge and gage grinding on bits with high gage wear).

Most rock with low quartz contents cause frontal wear, whereas rocks containing larger percentages of quartz cause gage wear.



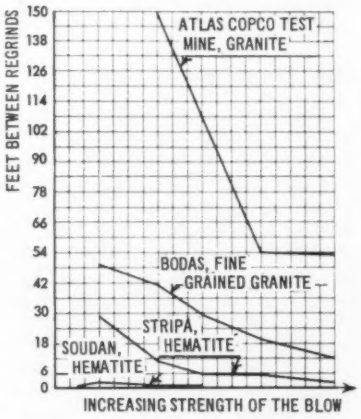
Rock and Rock Drills

By using different sizes of rock drills on different types of frontal wearing rock, wearing surfaces on inserts vary from very smooth to very rough. By using these wearing surfaces as a basis, a classification code has been made which shows the influence of the rock drill and the rock on the wearing surface (below).



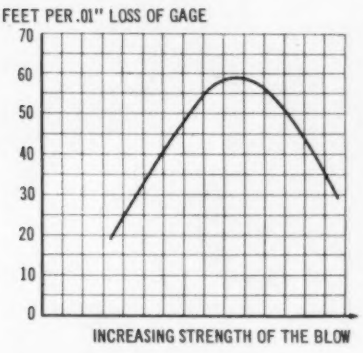
The appearance of the wearing surface is determined first by the rock and secondly by the size of the rock drill, and only thirdly by the influence of the carbide grade.

The footage obtained between regrinds, which is a criterion of the wear, shows the same influence of the size of the rock drill and the properties of the rock as the roughness (below).



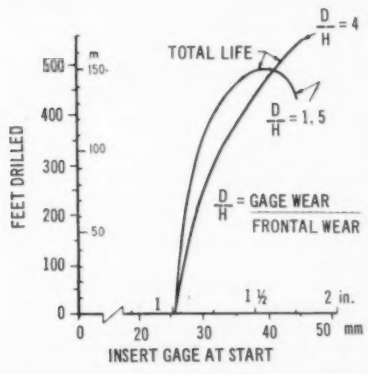
As has already been stated, the gage of the insert is reduced heavily in rocks with a high quartz content, but, even here, the size of the rock

drill has a great influence on the gage wear (below).



Influence of Gage on Insert Life

General opinion is that, in gage-wearing rock, a longer life can be obtained from an insert with a greater original gage. This, however, is only valid if there is very much more gage wear than frontal wear. The insert is then normally worn out on the gage before the height of the insert has worn down to such a low level that there is danger of breakage. If, on the other hand, the gage wear is only somewhat bigger than the frontal wear, a wide gage cannot be worn out, as the height of the insert reaches the critical level for breakage earlier (below).



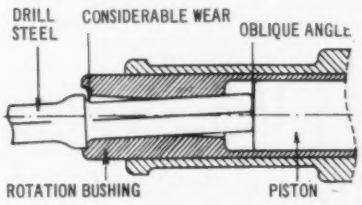
Thus it is not possible to increase the insert life by increasing the original gage, if the relationship between gage and frontal wear is too small.

In frontal-wearing rock, the influence of a large original gage is especially pronounced, because the stresses on the insert are greater with increased gages and an insert with a larger gage receives more stress cycles per foot drilled due to its lower drilling speed.

Care and Handling

To obtain maximum life in each type of rock is not only a question of a suitable balance between tungsten carbide, steel and rock drill, but also, to a great extent, a question of correct care and handling.

The drill steel is exposed to considerably increased stresses if drilling is done with a bent steel or with too-worn drill chucks or by not applying sufficiently strong feed on the rock drill or drilling with too dull an insert. A common mistake is that the drill chucks are not changed according to the recommendations of the rock drill manufacturer. If the drilling is done with chucks that are much too worn, the stresses on the drill steel are greatly increased because of the extra bending stresses which are added by the oblique blow of the piston (below).

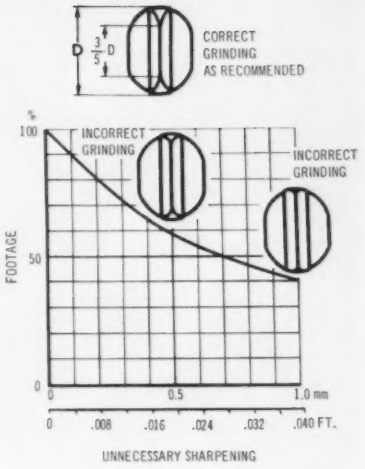


Drilling tests in which the effect of unsatisfactory feed has been studied (the rock drills were allowed to bounce approximately ½-in. on the shank) show that the life is only approximately 60% of the life of the steel when the correct feed is applied.

In order to obtain maximum life, the insert must be reground before it is too dull, otherwise the insert can easily break because of extremely high stresses. In certain favorable rocks, it can be advantageous to allow a bigger frontal wear than normally recommended by the drill steel manufacturers. A close check should, however, be kept to be sure that an increase in the total life really is obtained. The fact is that a dull insert creates extra stresses in the steel, which can result in far too many premature steel fractures—thus eliminating any gains made in the life of the insert. Furthermore, one should not take too much off the insert during the grinding operation. Grinding a sharp edge right to the periphery of the insert can spoil more than 50% of the insert life (diagram, above right).

A common reason for premature failures is the use of unsuitable grinding wheels or a faulty grinding technique, resulting in discolored, burnt, or polished surfaces on the tungsten carbide and the steel. Under these circumstances, the grinding wheel has clogged and glazed surfaces.

With unsuitable grinding, stresses



are created in the ground surface, which can lead to a breakage immediately after grinding, or after a short time of drilling. The most common reason for these breakages is a local overheating due to the use of too hard or too fine-grained grinding wheels.

The same fault arises if the grinding machine is faulty or if the grinding technique is wrong. If, for instance, the tungsten carbide is in contact too long with the grinding wheel, the danger of local overheating increases.

Deep grinding marks are created by excessive feed pressure, too coarsely-grained grinding wheels and unstable machines. Such marks are normally starting points for carbide fractures, and can result in premature failures.

To obtain a good life from the insert, it should not, under any circumstances, become burnt nor should the grinding wheel be allowed to clog with steel during the grinding operation. Unfortunately, too hard grinding wheels are very often used with the idea of increasing the number of regrinds for each wheel. The cost for grinding wheels is, however, only about 5% of the cost of drill steels. It is therefore obvious that it is poor economy to try to decrease the cost of grinding wheels by using hard wheels, if at the same time the risk of insert failures increases, resulting in an increased cost per ft drilled.

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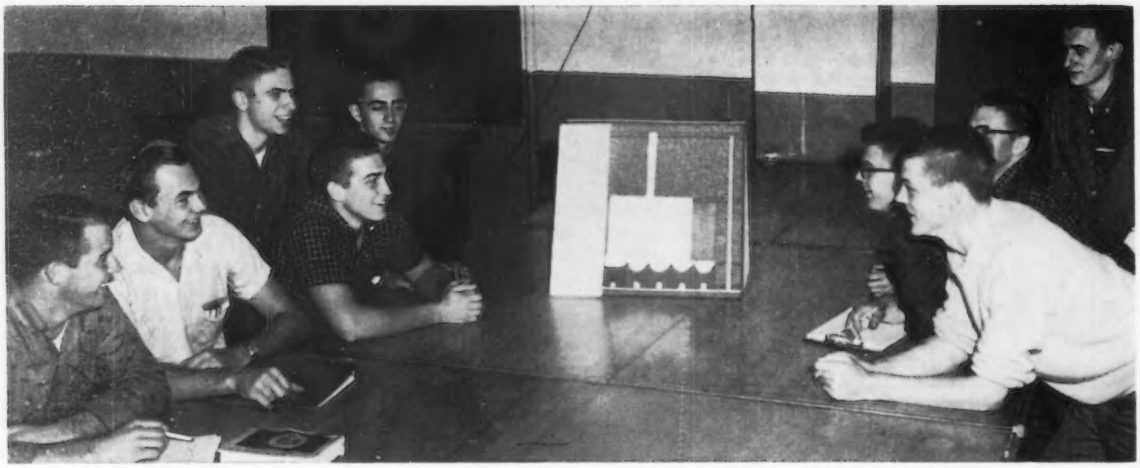


WORK-STUDY PLAN recently inaugurated at Penn State University is regarded by mining educators as an effective program to attract more students to the mining field. Shown above are some of the 25 participants in the plan.

What the Mining Industry Expects of Its Engineers

A. W. KNOERR

A YOUNG MINING ENGINEER made the following significant observation n MINING ENGINEERING, November 1960, p 1174: If the mining industry "would state with any degree of unanimity what *unique* services mining engineers can render the industry in the future, colleges and universities can better prepare future mining engineers." Acting upon this suggestion, E&MJ mailed questionnaires to more than 200 mining men in the U.S. and abroad in top supervisory or executive positions. Results of this survey were incorporated in a report presented by the author at the February AIME meeting in St Louis. This report explored two areas: (1) What unique services does the mining industry expect of mining and mineral processing engineers, and (2) What suggestions does the industry offer to educators to help revamp curricula to meet the needs of a changing industry.

Who Replied to Survey

To date, 158 replies have been received from 64 major and some smaller mining companies in the U.S. and abroad. Various divisions of larger companies were canvassed individually. Respondents were as follows: 18 company presidents; 14 vice presidents and assistants; 32 general or division managers; 28 assistant managers, resident manager, or managers of research and development; 15 general superintendents; 38 mine or mill superintendents and assistants; and 12 mining and metallurgical engineers. After the first 40 replies had been tallied, a definite pattern of opinions was discernable, which was merely reinforced by additional returns tallied later.

Questions asked in the survey and answers were as follows:

Part I. Industry Requirements

1. Do you want engineers:
   - A. Primarily for technical functions? Yes 17: No 15
   - B. As potential supervisors and executives? Yes 39: No 0
   - C. Or both? Yes 144: No 1

2. Please check the technical functions which you expect a mining engineer to perform.

Planning mine development	141
Computing reserves	136
Planning mining methods	133
Survey and mapping	132
Report writing	128
Mine examination and evaluation	117
Progress reports	117
Keeping engineering records	108
Ventilation and dust control	107
Cost control	101
Research	100
Drilling	89
Blasting and explosives	88
Materials handling	71
Ground stabilization	62
Subsidence	62
Rock mechanics	57
Hydraulics	50
Mine plant design	98
Equipment evaluation	97
Sampling	97
Equipment design	96
Drainage and hydraulics	94
Time studies	94
Methods evaluation	89
Drafting	88
Maintenance studies	82
Mine mechanical problems	81
Cycle planning	73
Mine electrical problems	68
Mining law and claim maintenance	63
Job evaluation	61

3. Please check the technical functions which you expect a mineral extraction engineer to perform.

Evaluating mill records	122
Revising flowsheets	114
Report writing	112
Ore testing	110
Planning flowsheets	110
Equipment evaluation	100
Research	99
New extractive methods	93
Reagents	90
Grinding media	89
Pumping solids in pipelines	81
New equipment	79
Cost control	97
Quality control	96
Materials handling systems	95
Keeping mill records	91
Mill plant design	90
Safety	84
Sampling	83
Waste disposal	80
Mill mechanical problems	75
Dust control	68
Assaying and chemical analysis	67
Mill equipment design	62
Mill electrical problems	61
Drafting	60
Job evaluation	50

Many respondents qualified their remarks by explaining that although no

single engineer would be expected to perform all of the functions listed under questions 2 and 3, training should be basic enough to permit a man to handle any one of the foregoing jobs with a reasonable amount of on-the-job training.

4. Please check the positions which you expect engineers to fill in operating divisions:

Mine

Assistant superintendent	137
Superintendent	134
Foremen	108
Shift bosses	87

Mill

Assistant superintendent	129
Superintendent	125
Foremen	101
Shift boss	71

Many respondents specifically added such titles as manager, chief metallurgist, resident engineer, chief engineer, general superintendent and others "right up to the top, even chairman of the board."

There seemed to be general agreement that not enough attention is given to management skills in the current mining curriculum. One company official maintained:

"Engineering management has a real responsibility here. I would be the last to deny that professional and technical competence are of increasing and absolute importance in today's complex industrial picture. However, we need engineers who are also businessmen, who can evaluate and plan the consequences of their professional work and who can manage the human assets of industrial enterprise in ways that are appropriate to the kinds of minds involved."

6. Check any of the following qualifications which you think are requisite for a good engineer:

Resourcefulness	146
Cost consciousness	140
Ability to write	133
Supervisory ability	132
Compatability	128
Inventive ability	78
Public speaking ability	77
Ability to type	14

There was consistent emphasis on the mining engineer's ability to express himself, particularly in writing. Some felt that mining schools ought to require some proficiency in at least one foreign language. One engineer felt that,

"Many engineers are being graduated who are quite competent technically, but who have little ability to express themselves, either in writing or by speaking. Few have any concept of labor unions, corporate structure, and related subjects which are not engineering, but important in any mining enterprise."

Other qualifications suggested were judgement, loyalty, supervisory ability, open mindedness, integrity, and ingenuity.

7. Does your company have:

A. A program to train engineers to become management or executive aides? Yes 56: No 95

B. Conduct or finance post-graduate training in business, managerial or advance technological phases of mining? Yes 44: No 102

C. Hold staff meetings with engineers to solve management and operating problems? Yes 127: No 25

D. Support or hold technical seminars? Yes 49: No 89

8. Is there a trend in your company to use fewer mining engineers and more civil, electrical, mechanical, industrial and chemical engineers? Yes 49: No 89

Note: Since many of the companies who replied "No" to this question were large ones, mine operators and educators feel that it should be appraised very carefully. Increase of this trend now noticeable in 40- to 50% of the industry could mean a change in demand for mining engineers trained in the traditional manner.

Part II. Industry's Suggestions to Educators.

1. Does the mining industry require more specialization in the training of engineers? Yes 23: No 122

2. The following plans have been proposed to improve mining curricula. Please check those which you consider favorable, and underline the one which you prefer most.

Plan A. Break down mining curricula into six specialties;

Mining engineer
Mineral processing engineer
Extractive metallurgical engineer
Mining research engineer
Metallurgical research engineer
Mining executive

Plan B. Restrict curricula to two four-year specialties:

Mining administrator
Mineral engineer

Plan C. Combine the last two in a five-year course.

Plan D. Expand present mining curricula to a five-year course.

Plan E. Intensify training with a three-semester year. This gives the equivalent of a six-year course in four.

Plan	Preferred	Also approved	Total
A	20	19	39
B	16	14	30
C	29	30	59
D	37	30	67
E	20	21	41

Replies to this question indicated that industry favors a more intensified and longer training period.

Some of the respondents felt that graduate schools were the answer:

"Let the 4-year graduate come back for two to three semesters for an M.S. in geology, metallurgy, advanced business, etc."

"Let's encourage graduate study for those who are capable. For those who are not interested or able, four years are enough."

One mine manager suggested that, "Four-year courses should be supplemented by heavy reading, and reporting assignments should be given for completion during vacation periods."

However a few respondents asked, "What's wrong with the present four-year course?" Educators indicated that it would not be practical to institute a three-semester year. They also said that summer vacations were necessary to give students a chance to earn money and gain practical experience in mines and mills. Many of the respondents who favored Plan A cut down the number of specialities to three or four instead of six, and some objected violently to including the mining executive degree. Said one, "We don't expect a mining school to turn out mining company presidents, or even vice presidents upon graduation."

3. A recent survey of mining school curricula showed the following courses are being offered to students. Please check those which you think necessary for the training of a mining or mineral processing engineer.

Mining

Elements of mining	136
Mining methods	135
Mine surveying	130
Mine management	125
Mineral economics	119
Mine evaluation	114
Materials handling	112
Ventilation	112
Mine plant design	111
Mine design	108
Mining Law	104
Prospecting and developing	96
Mine rescue and safety	92
Rock mechanics	91
Seminars	67

Mineral Processing

Ore dressing	136
Metallurgy	128
Fire assaying	76

Geology

Mineralogy	139
Geology of ore deposits	130
Structural geology	123
Physical geology	106
Petrology	99
Historical geology	84

Mathematics

Basic, through first year calculus	128
Advanced, second year calculus	97

Chemistry

Qualitative and quantitative	119
Physical chemistry	100

Engineering and Physics

Drawing	135
Mechanics of materials	131
Plane surveying	127
Electrical engineering	119
Statics and dynamics	112
Fluid mechanics	110
Structural design	109
Thermodynamics	93

Humanities

English	143
History	91
Psychology	88
Literature	74
Philosophy	57
Music	14
Art	12

Others suggested

Labor relations	25
Accounting	19
Business administration	16
Report writing	16
Economics	13
Public speaking	11
Industrial engineering	9
Cost accounting	7
Geophysics	3

4. It has been suggested by some men in industry that fundamental, technical and engineering subjects such as science, mathematics, physics chemistry etc., should be given more time and emphasis in mining curricula because the more practical courses in applied science tend to become out-dated by technological progress. Do you agree with this idea? Yes 114: No 36

5. Should engineers be required to spend more time as muckers, miners, train operators, mill operators, shovel operators, truck drivers, etc. to give them a better understanding of the practical side of mining? Yes 38: No 44: Not required but advisable 78.

One mine manager commented, "Practical training in mining, ore dressing etc. is best done by the companies. Companies should expect and plan practical on-the-job training for new engineers. The practical training I endured with muck stick, drifter and ball mills was a damned waste of my time. I learned in three years what I could have learned in three months, had mining companies emerged from the Neanderthal school of management."

Although opinion appears to favor fundamental courses, answers to question 3 above, and the functions performed by mining and mineral engineers listed previously, indicate that "bread and butter" courses such as fire assaying, drafting, surveying, ore dressing etc. should not be abandoned. Among those who answered "Yes" to question 4, one respondent suggested, ". . . plenty of basic science, English, humanities and economics, with introductory and broad coverage of specific courses in mining, geology and metallurgy.

"With this, actual on-the-job activities will firm up specific needs and knowledge for competence as a mining engineer."

But one operator who answered "No" to question 4 simply asks, "Why not up-date the practical courses?"

6. Assuming that an engineer has had an extensive and acceptable training in fundamental science, mathematics, English etc., would your company be willing to train the engineer through on-the-job schedules in such practical techniques as drilling, blasting, mine support, mining methods, ore testing etc. Yes 123: No 20

Does your company do this now? Yes 109: No 36

7. Educators would like to know if you favor the work-study program now in practice in some areas. Under this plan, two men alternate with each other between employment in sponsoring mines and school. Such programs provide financial support, produce more seasoned graduates, induce more interest in school courses, and give employers a chance to size up participants for future purposes. Do you favor the work-study plan? Yes 115: No 28

Does your company support a work-study plan? Yes 33: No 107

Other Comments Offered

Additional information offered by respondents was generous, but it took no particular pattern. Here are some examples:

"Ability to get along with people should be stressed."

"Mining engineers need to know more than the techniques of their profession—they need to be educated."

"Engineers should be more conscious of the importance of labor relations."

"Compatibility, ability to communicate, and resourcefulness characterize those persons in our company who were originally engineers but have progressed to supervisory and administrative duties—as high as the president and chairman of the board."

"Never quit studying—professional subjects and others in social, political and civic fields."

"I expect an engineer to be able to handle the work in his department after a short breaking-in period. Many graduate engineers that I have hired have not had the proper training to be able to 'carry on'."

"Development of the ability to work with people is very important."

"An engineer should be, first of all, a good engineer—which means a thorough basic grounding in fundamentals."

"Training in industrial engineering would be a valuable addition to regular training."

"Many young engineers lack the practical approach to problems that can only be acquired through experience."

What's To Be Done?

Donald C. McLaughlin, one of industry's esteemed and distinguished representatives, and a veteran and consistent attendant of AIME mineral education sessions, observed that the issues, comments and discussion at the 1961 convention were similar to those which took place 25 years ago. McLaughlin saw nothing distressing in the fact that educators disagreed on what the ideal mining curriculum should be; in fact, he said, industry profited substantially by being able to draw recruits from so-called mining trade schools which lean more toward the practical and business side of mining and less toward the advanced scientific and academic courses. In his opinion, we need them all.

Now, in addition to this refreshing viewpoint, another bright spot of opportunity for action grew out of the meeting. First there was the general observation that the enrollment in mining schools for the U.S. as a whole is falling at an alarming rate. But this was superseded by comment showing that enrollment could be stimulated immensely by the work-study plan which an increasing number of mining schools are developing. Under this plan two-man teams of students alternate with each other in working at mines which sponsor the plan and in study sessions. (See illustration, and E&MJ. March 1961, p 129.) Penn State College reported excellent results. Cooperating companies in many states have not only participated in the plan, but have been instrumental in recruiting students for Penn State's mining courses. Advantages of the work-study program have been outlined in Question 7. It is obvious from the questionnaire returns that although many mining companies do not participate in work-study plans, they consider it most attractive. Note that although 115 respondents favored the work-study plan, only 33 said that their companies supported a work-study plan. As evidence that promotion of the work-study plan will attract students to the mining profession, here are some comments offered freely in the questionnaire survey:

"The work-study plan has advantages for those students who need financial assistance."

"We support the work-study plan to the limited extent that we can."

"We don't support the work-study plan, but we should."

"The University of Minnesota is just starting to promote a work-study program. We will support it as much as possible."

"I don't have a well-based opinion on this, as I don't know anything of such programs."

The Educator's Viewpoint

As a counterpart to the survey of industry opinion reported thus far, Evan Just, head of the Department of Mining Engineering, Stanford University, canvassed opinion of educators. Highlights of his conclusions are as follows: (1) It is believed that industry should clarify its needs for mineral engineers. (2) There is no need for specialized curricula in mining schools. The current four-year curricula provide a good basis for any modification that may be necessary to meet changing conditions. (3) Educators see no consistency in industry's opinion and believe that most industry concepts are not abreast of current educational policies. (4) With respect to the so-called work-study programs affording students an opportunity to alternate study terms with employment terms, four mining schools reported that they have used the method and are enthusiastic about its advantages. (5) Most educators believe that the mining industry is making a tragic mistake by not competing more successfully with other industries for the engineering talent available at universities.

Just said that most educators believe that the industry would profit by improving earning power during the first 10 years of employment and by "vivifying promotion policies for the proficient." He concluded by estimating that two-thirds of the job of making the mining industry more attractive to youths and satisfying to graduates appears to be industry's, and urged that industry provide a better image in the eyes of young men.

E&MJ's Parallel Survey

Prior to the questionnaire survey of industry viewpoint reviewed thus far, E&MJ addressed a similar questionnaire to all readers on p 22 of the December 1960 issue. Replies to this survey duplicated the opinions reported in this article remarkably. However, some additional points were brought out in the published questionnaire survey. Approximately 75% of mining men who responded, enthusiastically endorsed the portable pension plan which would obviate the loss of pension equities to engineers who transfer from one company to another during their careers. The responsibility of taking the next step to resolve this issue —that of assaying industry's attitude toward a portable pension plan— will be assumed by E&MJ unless mining engineers wish to delegate this assignment to some other agency or group. Letters from readers endorsing or opposing this plan, as in the past, will be most helpful in pursuing this issue to a happy conclusion.

Other issues brought to light in the published questionnaire are revealed in the following comment from readers:

Miners Speak Out on Education

"A point where, in my opinion, our mining industry is 'slipping' is the failure to send engineers-in-training to graduate work. In the 12 years I have been teaching in graduate work, I have had about 30% American students and 70% foreign students—the majority of the latter being supported by funds from this country.

"I am very much afraid that in 10 to 15 years we will have raised a formidable competition by better trained and more qualified engineers of other countries."

"The engineers of my acquaintance find most of their problems are 'political in nature instead of technical.' If over 50% of an engineer's problems are problems in human relationships, then our mining schools are teaching their graduates less than half of what they should know.

"If all the recent graduates in mining engineering would realize they have gained only a fraction of the knowledge that is necessary for competence in their field, and industry realized it has an obligation to further this education with challenging tasks, then we would no longer need discussions of this nature."

"The value of changes in mining curricula seems to me very dubious so long as the mining industry utilizes engineers in the same fashion as they do today. It has been my personal experience that engineers are used to do surveying and/or supervising at the lowest level possible, until they acquire 'experience.' I don't dispute the value of experience. I contend, however, that the length of time during which a trained engineer acquires experience should be only a small fraction of the average time required by an untrained individual to acquire the same experience. Whatever changes are made in the curricula of mining schools, will not effect his career or his performance, if an engineer has to wait he is 30-35 or even 40 years old before he can utilize his knowledge. It seems to me that an effort should be made so that the mining companies start utilizing the engineering talent and acquired abilities of their employees at the earliest possible time after a short training course on the mine site. When this is accomplished, then engineers and mining companies can get together and request changes in curricula which would be advantageous to both. At this point the questionnaire seems one sided."

"Many of the subjects I studied have been useless. My best education while attending the Montana School of Mines was working underground to provide me with funds to continue my education. This experience has been most valuable. The graduating engineer today with no practical experience is beaten before he starts. I feel strongly that before a mining engineer graduates, he should have at least the equivalent of one year's practical experience. . . . I suggest training as is required in Africa to obtain an Overseer's Ticket—some modification of this should be included in the curriculum."

"We believe that the mining industry has not maintained the dignity of the young mining engineer. So called training programs involving manual labor and relegation to tasks best performed by high-school graduates have served only to lower his prestige and create a public image that does not reflect the mining engineer's true potential. By and large, the young mining engineer has not been properly utilized. There has been too much tendency to utilize him as a craftsman, rather than as a professional man. Too often his salary has been lower than the day-pay labor he associates with on the job, and whom he often directs and supervises. The mistaken assumption that the job satisfaction and reward of better jobs in the future will compensate is not only gross negligence, but immoral. It is not at all surprising that today's youngsters, fully aware of the mining engineer's status, are shying away from the profession.

"Our educators have been severely criticized for not graduating engineers with more specialized knowledge. Considering the limitations imposed upon them by generally apathetic alumni and/or industry, it is surprising they have done as well. We would urge them to continue turning out these bright, young, well-prepared engineers and commend them for their efforts to date. We would urge our educators to retain the general, well-rounded curriculum now offered, but expand it to include labor relations, to instill professionalism in the students, and to impress upon the students their obligation to participate in their community affairs as well as their professional affairs. We do not agree that the mining engineer's general education should be changed. The nature of his work demands exposure to other engineering branches and it is this general education that develops the analytical ability that is so necessary in dealing with mining problems."

AFTER 60 ft had been sunk solely with portable crane, this headframe was erected.

Using a home-made air-operated clamshell, this Nevada quicksilver mine sank a 171-ft development shaft in 4½ mo. Here you can read just how it was done, and on the next pages you'll find detailed cost figures on each phase of the operation.

Sinking the Small 'Corderito' Shaft: How It Was Done, What It Cost

WORKMAN stands by clamshell, lying on ground adjacent to shaft collar, then . . .

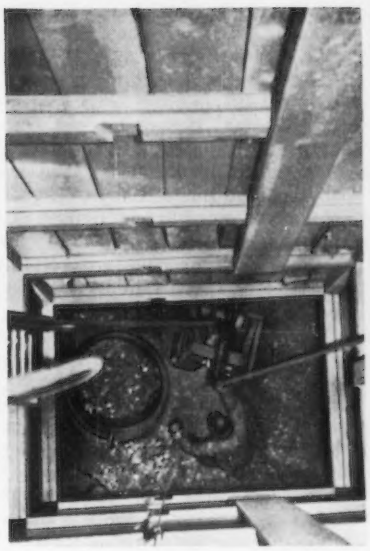
steadies it as hoist picks it up and prepares to lower it for a working turn.

J. ELDON GILBERT

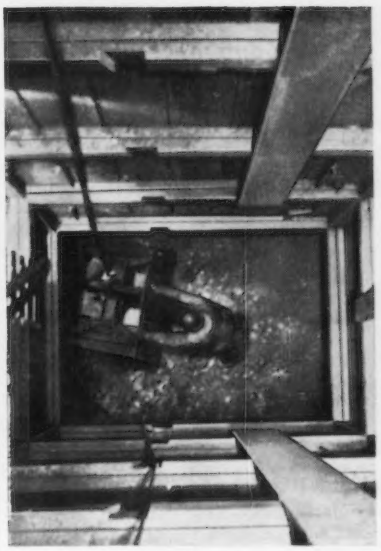
WHEN CHURN-DRILLING EXPLORATION, carried out recently on the Cordero mine holdings of Cordero Mining Co., McDermitt, Nev., disclosed a new orebody, it was situated too far from existing underground work to be explored from the main shaft serving the Cordero quicksilver mine. The orebody was shallow, lying between 100 and 150 ft below the surface, and apparently quite small. These conditions made it necessary to sink a small development shaft, subsequently named the "Corderito." In view of the small size decided on, it was imperative to keep sinking costs at a minimum.

The location of the new work to be undertaken was far enough from the mine and mill so that it could easily be conducted as a unit separate from the general mine operation. Here, power and air were not available, and, as a consequence, power-generating equipment and an air compressor were moved to the site. These, and other equipment owned by the company, were freely used, and a record was made of their operation. For the purpose of determining costs, labor, supplies, and permanent equipment were charged at cost. However, temporary equipment was charged as though rented. Rental prices were determined by regular industry rates, with due consideration for condition of equipment.

Mr. Gilbert is general manager, Cordero Mining Co., Palo Alto, Calif.

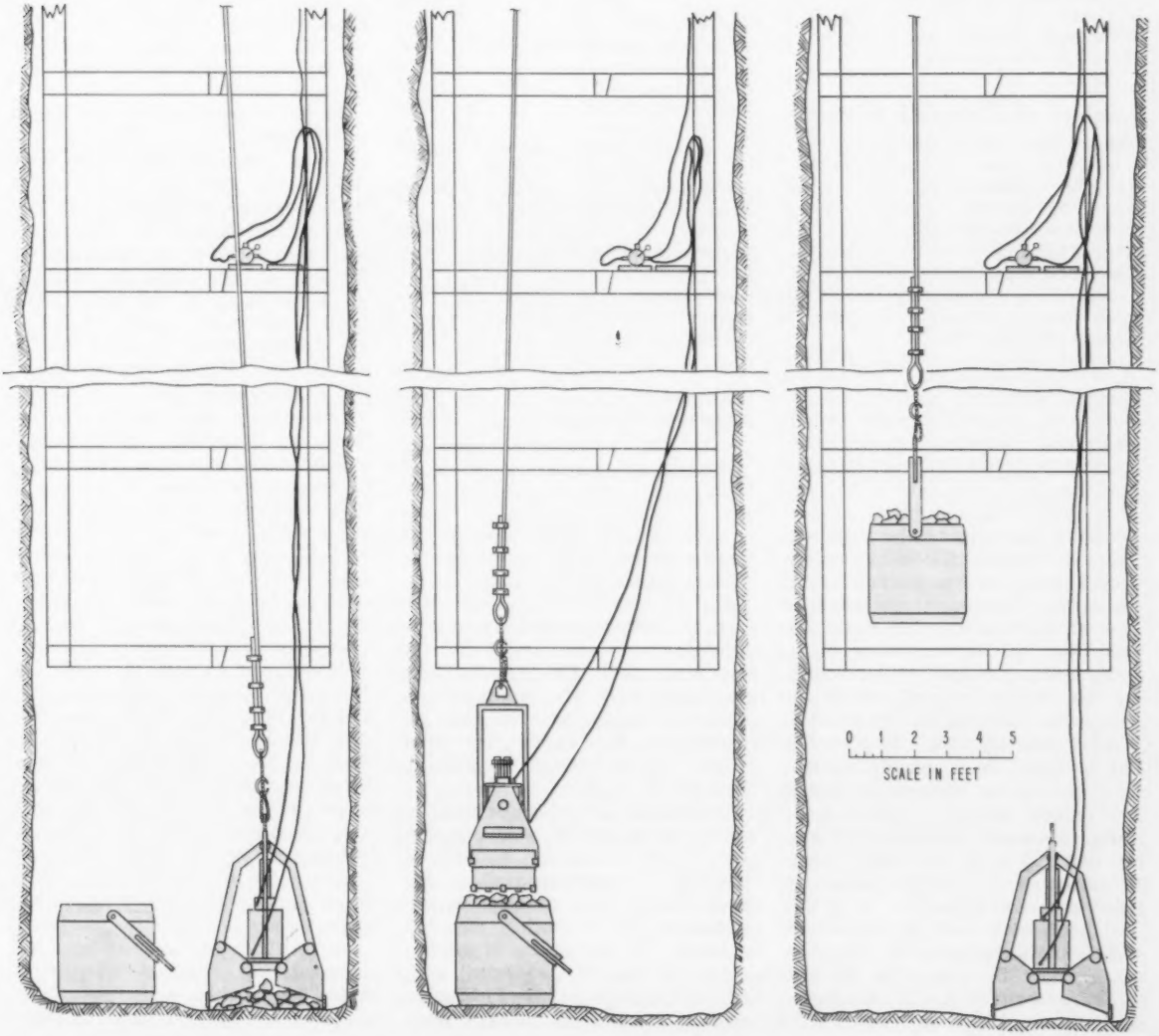


STEP 1: Workman, signaling to operator, positions clamshell to grab load of muck.



STEP 2: With clamshell full, he moves it over hoisting bucket, where it's dumped.

STEP 3: When full, bucket is hoisted out of shaft, man taking cover under timber.



Speed of Shaft Sinking (Per Day)

Mucking	
Total number of buckets with clam	38
Total time mucking with clam	4 hr 55 min
Total number of buckets hand mucked	3
Total time hand mucking	1 hr 5 min
Total time mucking	6 hr
Timbering	
Distance center to center of rings	6 ft
Total time to timber 1 ring	5 hr 46 min
Drilling and Blasting	
Depth of holes drilled	6 ft
Time to drill 21-hole round	4 hr 31 min
Time to blow and load holes	1 hr 13 min
Time to air out	45 min
Total time drilling and blasting	6 hr 29 min
Miscellaneous Work and Time	
Paid lunch period	1 hr 35 min
Paid travel time	45 min
Miscellaneous time	1 hr 50 min
Total other time	4 hr 10 min
Total Time to Complete Cycle	22 hr 25 min
Dead work pro rated	1 hr 30 min
Total Overall Time per Cycle	23 hr 55 min

Speed of Clamshell Mucking

Depth below collar at time of study	149 ft
Capacity of clamshell	3 cu ft
Capacity of bucket	18 cu ft
Number of clams/bucket	5.92
Time Mucking	
Change cable from bucket to clam	0.70 min
Load bucket	3.65 min
Change cable from clam to bucket	0.85 min
Hoist, dump, and return	2.60 min
Lost time waiting for trammer	—
Total actual time per bucket	7.80 min
Cable speed, Loaded	264 ft/min
Cable speed, Empty	83 ft/min

Cost of Surface Plant for Corderito Project

Headframe Construction		
Steel 12,000 lb	$1160.00	
Bearings	130.00	
Sheave and shaft	162.00	
Welding rod, bolts and miscellaneous	100.00	
Labor design	360.00	
Labor fabrication 193 hr	579.00	
Labor supervision and engineering	200.00	
	$2691.00	
Headframe Erection		
Footings—cement and lumber	150.00	
Labor—erection 122 hr	366.00	
Labor—supervision and engineering	450.00	
	$ 966.00	
Total Headframe		**$3657.00**
Hoist Repairs		
Boise businesses	$ 549.00	
Transportation	75.00	
Labor—Repair 48 hr	144.00	
Labor—supervision	200.00	
	$ 968.00	
Hoist Erection		
Foundation—cement and lumber	100.00	
Labor—footings 24 hr	72.00	
Labor—hoist 56 hr	168.00	
Labor—supervision	300.00	
	640.00	
Total Hoist		**$1608.00**
Building 16 x 20 @ $3.00 per sq. ft.		**960.00**
Power and Compressor		
Labor—move in power and compressor—80 hr	$ 240.00	
Labor—skip dump and collar 80 hr	240.00	
	480.00	
Grand Total		**$6705.00**
10% for contingencies		**670.50**
		$7375.50

During the period this work was done, all mine employees of Cordero were included in a production bonus, which, for shaft men, amounted to 21% of the base pay. This bonus has been included in the labor costs. Other costs included in this charge are the "fringe benefits" which are more-or-less uniform for the industry.

An effort was made to keep the sinking operation completely separate from the regular business of mining and milling, and to consider it as though it were a prospecting project, far removed from the main mine. This attempt in isolating the new shaft failed in several respects:

1. Equipment and supplies were available without delay or problems which might have occurred if they had been acquired for the Corderito shaft alone.

2. Labor, as needed, could be transferred between the main mine operation and Corderito.

3. The camp at the main mine operation, (including housing and boardinghouse) was used freely for the new shaft. Costs for these facilities are charged only the average amount lost by the entire operation. They are charged pro rata to the new shaft as part of the "fringe benefits" in labor costs.

4. While a working superintendent was in charge of the sinking operations, all other members of Cordero's staff were immediately available for advice, information, or help. In this connection, the following men all contributed to the success of the operation: Herbert H. E. Mitchell, general superintendent, Elwin Fisk, mine engineer, Arleen Buck, assistant mine engineer, C. R. "Ole" Johnson, master mechanic, and Clarence McClain, work superintendent.

The Corderito shaft measures 8ft-8in. x 6ft-4in. in cross-section outside the timbering. It contains one compartment and a half. The hoisting compartment is 60x52 in., and the half compartment 60x30 in. Timbering is made up of 8x8-in. timbers and 2x12-in. lagging. The sets have conventional framing and are on 6-ft centers. Sinking operations were carried on to a depth of 171 ft.

Work was started on the shaft on April 14, 1960, with a 10B Backhoe digging the first 10 ft. After the collar timbers were set in cement, a P&H crane with a 45-ft boom moved in. This unit handled all the hoisting for the first 60 ft. During this period all dividers were left out, though ladders were nailed to the end plates on the manway end. Drilling the shaft round, consisting of 21 holes 6½ ft deep, was done with hand-held sinkers; and blasting the completed round was carried out with 1⅛x8-in. Atlas Gelodyne No 3. Powder consumption per 6-ft advance amounted to about 48 lb. Blasting caps were of the regular-delay electric type.

Many months before the shaft-sinking project was started, an air-operated clamshell had been built from plans and description by J. W. Lower (MINING ENGINEERING, July 1958). Alterations in size and dimension were made to fit conditions at Cordero. It was originally built to muck the sump of the main shaft. Later it was used to sink a winze in the Cordero mine, followed by its use in the Corderito sinking. Capacity of the clamshell is 3 cu ft plus.

Mucking of rock broken in the shaft was done with this clamshell unit suspended from the P&H crane. Its opening and closing are controlled by manipulation of air valves at the surface that control the air pressure on a two-way air cylinder connected to the clam jaws. During a mucking cycle the hoistman lowers the clamshell to a positioning man at the bottom of the shaft, who moves the clamshell, swinging free on the cable, to the best loading point, and then signals the valve operator to close the jaws thereby loading it with rock. Next, he steps under protective timbering and signals for the loaded clamshell to be hoisted to the surface. Arriving at the surface, it is dumped by using the valves mentioned; then it is again lowered into the shaft. This means that the clamshell was hoisted to the surface each time for dumping.

To handle timber and supplies, the clamshell was removed when not needed for mucking and replaced by an 18-cu ft sinking bucket. Because

Cost Breakdown

April 14 to May 13
22 working days, 60 ft sinking

22 Days	Equipment	@ 29.00/day		$ 638.00
22 Days	Fuel	@ 7.50 "		165.00
60 Ft	Supplies	@ 15.89/ft		953.40
352 Hr	Shaftman	@ 3.48/hr		1224.96
176 Hr	Superintendent	@ 5.00 "		880.00
Contingencies		@ 10%		381.97
				4243.33

Equipment	Cost per ft	$11.70
Supplies	"	20.43
Labor	"	38.59
Total		$70.72

June 15 to Sept. 2
50 working days, 111 ft sinking

50 Days	Equipment	@ 39.00/day		1950.00
50 Days	Fuel	@ 7.50 "		375.00
111 Ft	Supplies	@ 15.89/ft		1763.79
384 Hr	Shaftman	@ 3.48/hr		2707.44
384 Hr	Superintendent	@ 5.00 "		1920.00
Contingencies		@ 10%		863.30
				9579.53

Equipment	Cost per ft	19.32
Supplies	"	21.12
Labor	"	45.85
Total		86.29
Sinking Cost per Ft (171 ft)		80.83

May 16 to June 14
21 working days, erect surface plant

Headframe	4022.70
Hoist	1768.80
Building	1056.00
Power, air and collar work	528.00
	7375.50
Total money spent	**$21,198.36**

Equipment, Supplies and Labor Cost Breakdown

Equipment (First Phase) by Month and Day

Portable compressor	@ $250.00/mo	Approx.	$10.00/day
P&H crane	@ 250.00 "	"	10.00 "
Air clam	$ 600.00 x 10% "	"	3.00 "
Machines—steel hoses, etc	$1200.00 x 10% "	"	6.00 "
Fuel			7.50 "

Equipment (Second Phase) by Month and Day

D-17000 Caterpillar generator	@ $450.00/mo	Approx.	20.00/day
Compressor (electric)	@ 250.00 "	"	10.00 "
Air Clam	$ 600.00 x 10% "	"	3.00 "
Machines—steel hoses, etc	$1200.00 x 10% "	"	6.00 "
Fuel			7.50 "

Supplies

Timber	111 fbm/ft x $90.00/M framed	10.00/ft
Powder	8 lbs/ft x 25¢	2.00 "
Caps	3½ ft x 26¢	.91 "
Connecting wire		.10 "
Pipe 2 in	56¢ plus fittings	.75 "
Pipe ½ in	13¢ " "	.18 "
Pipe 12 in. vent		1.00 "
Hanging rods	¾ in. 5 x 16¢	.80 "
Electric wiring		.15 "
		15.89 "

Labor

Shaftman	@	2.32/hr
NIC		7 %
Equitable		3 %
OAB		3 %
Nevada unemployment		2½%
Federal unemployment		½%
Boardinghouse or camp		8 %
Vacations	1 yr 2% 2 yr 4%	
Christmas bonus		1½%
Tonnage bonus		21 %
		50½%
Total shaftman		3.48/hr
Superintendent (Working)		5.00 "

of the slow hoisting speed of the crane and the long air hoses required, this system was considered uneconomical beyond 60 ft. This point was reached May 13, 1960, after 22 working days. Average sinking rate was 2.72 ft/shift.

On May 16, 1960, the erection of a 32-ft steel headframe was started. Also, the 75-hp double-drum hoist from the M shaft was overhauled and installed along with a D-17000 Caterpillar generator set for production of electric power. In addition, a 315-cu-ft Ingersoll-Rand motor-driven compressor, fans, and other surface-plant equipment, including bucket dumping facilities and buildings, were installed and erected. The entire job was completed on June 14.

The second phase in sinking was started on June 15. All procedures remained the same, except that the hoist and sinking bucket were used in place of the crane and clamshell for hoisting to the surface for dumping. The valve operator was stationed about 30 ft above the shaft bottom, and not on the surface, as he was during the initial sinking. Because of the small size of the shaft, the clamshell and sinking bucket had to be handled from a single line from the hoist. After the bucket was lowered and set on the bottom of the shaft, the line would be disconnected and transferred to the clamshell for mucking. About six clamshell loads would fill the sinking bucket. The line then would be disconnected from the clamshell and reconnected to the sinking bucket for hoisting to the surface. This procedure was used for the balance of the sinking project.

The 171-ft point was reached on September 2. The 111 ft of the second part of the sinking job required 50 working days, for an average sinking rate during the period of 2.22 ft per working day.

During this period the average time required to complete one 6-ft set was as follows: drilling the shaft round (21 holes, 6½ ft deep), 5 hr; loading holes, blasting, and clearing, 2 hr; mucking with clamshell, 4 hr; mucking by hand, 1 hr; timbering, 5 hr; and miscellaneous pro-rated time, 5 hr; or a total of 22 hr.

The original cost of building the clamshell was $472.00. Some alterations and repairs were necessary before the shaft was completed, but the total amount of money invested is less than $750.00. This is a striking contrast to the cost of most other shaft-mucking equipment. The breakdown of costs for surface-plant equipment, supplies, and labor (and also for the time study of clamshell mucking) is given here in separate tables.

The Corderito shaft was sunk in two stages—the first down to 60 ft. As mentioned previously, this took 22 working shifts with an average advance of 2.72 ft per shift and at a cost of $70.72 per ft for sinking. The second stage from 60 to 171 ft took 50 working shifts with an advance of 2.22 ft per shift and at a cost of $86.30 per ft for sinking. Cost for the entire 171 ft averaged $80.63 per ft. The only outlay not charged to shaft sinking was $7375.50 spent on headframe, hoist, and surface plant.

Operating Budgets—A Tool for Planning and Controlling Costs

DONALD N. TREMPER

BECAUSE conditions within our companies change rapidly, special tools and techniques for planning, coordinating and controlling operations are necessary. Progressive companies rely on two of these tools, forecasts and budgets, as a base for making decisions—decisions which often must be made quickly to adjust to internal and external change.

Herman C Heiser, CPA[1], pointed out in his book, BUDGETING, that budgeting should serve the threefold purpose of planning, coordination and control, purposes which also summarize the phases of a properly operating budget system.

Four Steps to Planning

The planning phase of budgeting consists of the following steps:

1 Major objectives are specified by top management.
2 Detailed policies, plans and assumptions are formulated by each level of supervision.
3 Plans are coordinated and amended.
4 Final budget is approved by top management and "go ahead" signal is given.

How well the planning is done depends largely on the organization's "chain of command" and the accounting system. An effective "chain of command" requires that supervisory authority and responsibility be clearly designated right down through the departmental level. An effective accounting system requires, among other things, that costs be accumulated and reported for each cost center. In the National Association of Accountants' NAA BULLETIN of July, 1958, Victor Schmidt[2] writes:

"The most practical method for allocating, collecting and controlling costs of direct labor and expense is the use of the cost center as the basic unit to be costed. A cost center usually embraces similar activities, and functions under the definite authority and responsibility of one supervisor and his assistants."

Coordination Is Vital

Another vital phase of the budget system is coordination. Coordination and cooperation must permeate each budget from start to finish. It is manifested in the assistance rendered by the accountants and engineers to the various departments in the preparation of their departmental budgets. It is manifested in the integration or modification of the plans and activities of the various departments, divisions, plants and projects. At Pima Mining Co., the budget is the tool that demonstrates the interdepartmental relationships and stimulates coordination and cooperation in all activities.

Cost Control Is Essential

Control is the third purpose and phase of an operating budget system. The budget sets up comparisons and checks to show the degree and quality of operating performance. Actual performance should be compared with the budget to indicate when and where changes in current operations must be made in order that the planned objectives may be realized. At Pima Mining Co., each operating department prepares daily performance reports. These reports show both the daily and the month to date performance. The operating departments prepare monthly descriptive and statistical reports, along with the service departments.

Concerning cost control, Peter M. Chiuminatto[3] writes in the N.A.A. BULLETIN as follows:

"Unless a budget results in control of costs and expenses, it is useless. The most effective control is accomplished by comparing the actual cost and expenses with budgeted costs and expenses on the most frequent bases practicable, daily if possible, weekly if not, monthly if no greater frequency can be achieved. The objective is to know as soon as possible the difference between actual and budget, and make corrections with equal promptness."

To compare the actual cost with budgeted costs, at Pima Mining Co., the accounting department prepares the following operating reports or statements (see illustrations):

Form 1. Summary of Operating and Cost Data Comparison with Estimates.

Form 2. Statement of Mine Cost Based on Material Moved (current month and another showing year to date).

Form 3. Statement of Milling Cost (current month and another showing year to date).

Form 1—Summary of Operating and Cost Data Comparison with Estimates

April 1961

	Estimates		Actual	
	Standard Month	Current Month	Average For Year	Current Month
Production:				
Yards alluvium stripped				
Yards ore and waste rock moved				
Total				
Dry tons milled				
Grade mill feed—% Cu.				
Total mill recovery—%				
Concentrate grade—% Cu.				
Pounds copper recovered in concentrate				
Operating costs:				
Mining (Form 2)	$	$	$	$
Milling (Form 3)				
General and administrative (Form 4)				
Total operating costs to f.o.b. mill concentrate bins*	$	$	$	$

*Excludes: amortization of development, depreciation, interest, and conversion costs.

Mr. Tremper has been office manager and chief accountant of Pima Mining Co., Tucson, Ariz., for nine years. Prior to this, he worked three years in oil production and transportation accounting, and one year in public accounting.

Form 2—Statement of Mine Cost Based on Material Moved

	April, 1961								April, 1960	
	Labor		Supplies and Parts		Other	Total	Cost Per		Cost Per	
	Operating	Repair	Operating	Repair	Costs	Costs	Dry Ton	Cu. Yd.	Dry Ton	Cu. Yd.
Dry tons treated										
Cubic yards moved by scrapers										
Scraper excavation:										
Direct costs	$	$	$	$	$	$	$	$	$	$
Distribution of general pit expense										
						$	$	$	$	$
Cubic yards moved by skip hoist										
Shovel excavation—skip hoist:										
Drilling	$	$	$	$	$	$	$	$	$	$
Blasting										
Shovel loading										
Truck hauling										
Skip hoisting										
	$	$	$	$	$	$	$	$	$	$
Distribution of general pit expense										
						$	$	$	$	$
Cubic yards moved by direct hauling										
Shovel excavation—direct hauling:										
Drilling	$	$	$	$	$	$	$	$	$	$
Blasting										
Shovel loading										
Truck hauling										
	$	$	$	$	$	$	$	$	$	$
Distribution of general pit expense										
						$	$	$	$	$
Total cubic yards moved										
General pit expense: (detail of expense distr. above)										
Road maintenance	$	$	$	$	$		$		$	
General mine equipment										
Supervision										
Payroll taxes and benefits										
Other costs										
	$	$	$	$	$		$			$
Diamond drilling	$	$	$	$	$	$	$	$	$	$
Total cost	$	$	$	$	$	$	$	$	$	$
Cost per dry ton	$	$	$	$	$		$			
Cost per cubic yard	$	$	$	$	$			$		

Form 4. Statement of General and Administrative Expense (current month and other showing year to date).

Subsidiary statements are prepared showing the actual costs of the electrical, mechanical and metallurgical departments. Separate monthly, and year to date, statements are prepared showing the mine equipment cost, under the cost elements of labor (operating and repair) and supplies (fuel, operating and repair). Not only are total dollar costs shown, but also the cost per cubic yard and the cost per operating hour.

Also, a break-even point statement is prepared, titled "Statement of Production Cost and Net Value of Production." From top management down to department head, great interest is shown in this statement; and it is constantly used in planning and control. Concerning break-even point as a "follow-through" analysis, Henry C. Doofe's[4] article in the N.A.A. BULLETIN of November, 1959, states:

"A working knowledge of break-even points is a matter of prime importance to today's business managers. Unfortunately, too few executives realize beforehand at what sales volume their operation no longer yields a profit. They seldom see the red until they are into it."

Before the break-even point can be intelligently studied, or control properly applied, it is essential for those con-

Form 3—Statement of Milling Cost

	April, 1961							April, 1960
	Labor		Supplies and Parts		Other	Total	Cost Per	Cost Per
	Operating	Repair	Operating	Repair	Costs	Costs	Dry Ton	Dry Ton
Dry tons of ore treated								
	$	$	$	$	$	$	$	$
Crushing—primary								
Crushing—secondary								
Grinding								
Flotation and concentration								
Thickening and filtering								
Tailings disposal								
Electrical								
Water								
Total direct cost	$	$	$	$	$	$	$	$
General mill expense:								
Assaying and sample preparation	$	$	$	$	$	$	$	$
Metallurgical								
Supervision								
Payroll taxes and benefits								
Other costs								
Total general mill expense	$	$	$	$	$	$	$	$
Total cost	$	$	$	$	$	$	$	$
Cost per ton treated	$	$	$	$	$	$	$	$

Form 4—Statement of General and Administrative Expense

	April, 1961							April, 1960
	Labor		Supplies and Parts		Other	Total	Cost Per	Cost Per
	Operating	Repair	Operating	Repair	Costs	Costs	Dry Ton	Dry Ton
Dry tons of ore treated								
	$	$	$	$	$	$	$	$
Administrative								
Accounting								
Engineering and geology								
Personnel, safety, and security								
Purchasing								
Warehousing								
General maintenance								
Payroll taxes and benefits								
Communications								
Donations								
General liability insurance								
Legal fees								
Los Angeles office								
Land rental								
Representative and umpire								
Sales commissions								
Sales tax								
Gold and silver difference								
Property taxes—								
Plant, equipment and ore								
Other expense or (income)								
Exploration of outside properties								
Total cost	$	$	$	$	$	$	$	$
Cost per ton treated	$	$	$	$	$	$		

cerned with the budget to know which factors and costs will not change with volume, and which will. COST ACCOUNTANTS' HANDBOOK, edited by Theodore Lang, CPA[5], states:

"For control purposes, costs are classified as fixed, variable, and semi-variable. . . .

"Fixed costs do not vary in total amount with changes in rate of production. Depreciation, insurance, and taxes

Form 5—Statement of Production Cost And Net Value of Production

	Per Ton of Ore Treated		Per Pound Marketable Copper	
	April 1961	4 Months 1961	April 1961	4 Months 1961
Units of production				
Cash costs:				
Mining	$	$	¢	¢
Milling				
General and administrative				
Interest				
	$	$	¢	¢
Plus: conversion state royalty				
	$	$	¢	¢
Non-cash costs:				
Depreciation	$	$	¢	¢
Amortization of development				
	$	$	¢	¢
Total costs	$	$	¢	¢
Less: silver credit				
*Breakeven point	$	$	¢	¢
Gross value at market price				
Net value of production before provision for taxes	$	$	¢	¢
Provision for taxes				
Net value of production	$	$	¢	¢
*Breakeven point				
Cash operating costs	$	$	¢	¢
Interest				
Non-cash costs				
	$	$	¢	¢
	$	$	¢	¢

are normally to be found among fixed costs.

"Variable costs tend to vary directly in total amount with variations in the rate of production. Workman's compensation insurance and royalties based on volume of production are of this type. Doubling the rate of production normally results in doubling the cost.

"In addition, there are semi-variable costs which vary in total amount with variations in volume of production, but not at the same rate. The cost of repairs and maintenance is usually considered semi-variable; a 50% increase in production may produce only a 30% increase in maintenance costs."

The accountant uses the term "variance" to refer to the difference or discrepancy between the budget and the actual results. There is no uniform method of analyzing variances. Different industrial accountants, CPA's, and textbook writers use a variety of formulas and methods in making such analyses. Generally, they agree that there are the following types of variances:

1 Efficiency variance.
2 Capacity, sometimes called volume or utilization variance.
3 Calendar or period variance.
4 Rate variance.

At Pima Mining Co., we informally consider all of these types of variances. The chief accountant touches on them briefly in his descriptive "Comments on Financial and Cost Statements", which is distributed to the operating management, with their copies of the monthly accounting statements. He also points out and discusses the departmental variances as he delivers the monthly statements to the various department heads. Inquiries for further details on the why's and how's of these cost variances are always welcomed in the accounting department. Effective budgeting demands that, after the variances are known, those responsible explain them. It is important that they report:

1 The reason for the variance,
2 Whether it will be offset before the end of the year, and
3 Whether or not the interim budget estimates should be changed at this time, or when the next quarterly budget is prepared.

We have a monthly round-table conference at which each departmental supervisor verbally reviews his statements and reports on the variances. Charts, graphs and tables can also be used effectively. These present a story, especially of trend, and can illustrate relationships which would take hundreds of words to describe.

Conclusion

Not only is this tool, the budget, applied to operating performance, costs and profit analysis, but it also has invaluable applications to cash requirements, economic and feasibility studies. However, like any tool, the budget's success in controlling today's operations, and guiding tomorrow's forecasting, is directly related to the effort spent in its planning, coordination, and control.

References

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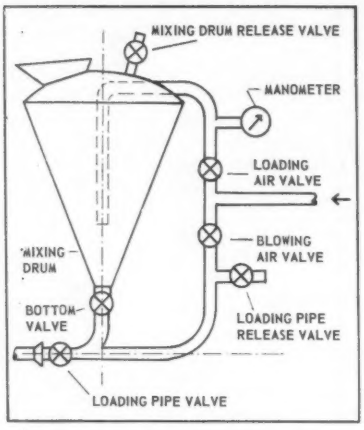
3 Peter M. Chiuminatto, *"Getting the Most Out of Operating Budgets,"* N.A.A. BULLETIN, August, 1960, Section 1, pp. 30, 31.
4 Henry C. Doofe, *"The Profit Path as Seen Through the Budgetary Control Program,"* N.A.A. BULLETIN, November, 1959, Section 1, p. 52.
5 Theodore Lang, CPA, (edited by), COST ACCOUNTANTS' HANDBOOK, pp. 135-138.

If Budget Management Is Your Problem, See the Guidebook Section . . .

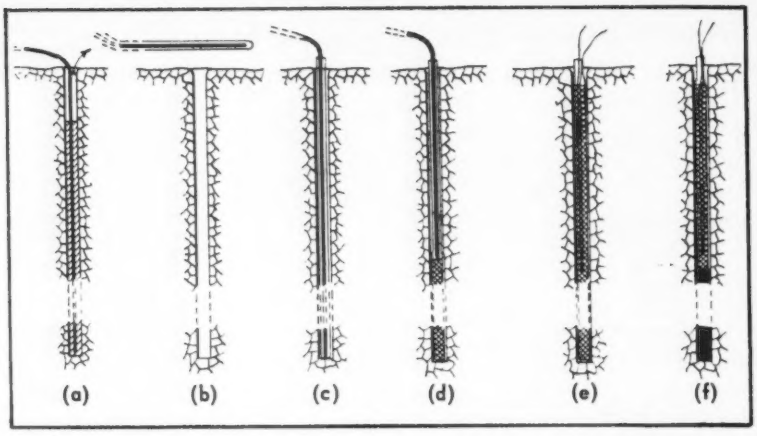
THE ENTIRE Guidebook Section of this issue is given over to costs and cost-cutting. Starting on p 181, with some studies of management problems and solutions in the cost reduction of mine operation, E&MJ's special issue breaks the problem down into the various major areas of industry expense.

Mine and plant operators, manufacturers and industry experts have collaborated with the staff in producing a good sample of today's cost-cutting practices.

You'll find dollars and cents listings of some fairly representative costs for drilling and blasting, hauling, crushing, processing and recovering ores. The editors encountered some reluctance to divulge costs in some areas; great willingness to share information in others. Where the story could be gotten, it is presented. The purpose of the issue is not to divulge secrets, but to exchange cost information among the industry to help the industry cut its own costs.



THIS UNIT loads blastholes of any reasonable length, at all inclinations.



TO LOAD wet holes, the loading tube is covered with a plastic bag and then inserted in the hole. The hole is then charged with AN-FO only or with a LFB bottom charge.

How The Pneumatic Loader Works and How Wet Holes Are Charged

WITH THE UNIT shown above, blastholes of any reasonable length and at all inclinations can be loaded. Even in vertical holes, spill will not exceed 5%.

For mixing, the drum is charged with one 25 kg bag of AN and a 1.75 l measure of oil. The bottom valve is opened, the pipe valve closed and compressed air is blown intermittently through the bottom of the mixing drum by opening and closing the valve for blowing air. After three minutes, the mixture is homogenous. Now the bottom valve is closed, the pipe valve opened and water that may possibly occur in the blastholes is blown out. Then the drum is closed, the bottom valve opened and the loading air conducted into the drum. At a loading pressure of about 2 to 3 kg per cm^2, the mixture is forced through the loading pipe into the hole. When the hole is filled, the loading air valve is closed and the release valve on the mixing drum is opened. Then the loading pipe is pushed into the next blasthole, the release valve closed, the loading air valve opened and loading goes on.

There are three main types of trouble that occur during loading. The first is a block in the loading pipe. Such a blockage can be cleared by closing the bottom valve and opening the blowing air valve (8 kg per cm^2). When the blockage is removed, the valve for blowing air must be closed and the release valve for the loading pipe be opened quickly; otherwise the high pressure of the blowing air would blow the AN out of the hole.

The second trouble that occurs is bridging in the mixing drum. This trouble is reduced by: (a) a polished stainless steel lining in the mixing drum, and (b) a water separator in the air line before the loading unit.

The third trouble is the water problem. This is overcome by a technique illustrated above. The problem of wet holes is overcome by using plastic bags corresponding to the length and diameter of the blasthole. After blowing the hole (a), threading the plastic bag onto the loading pipe (b) and introducing it into the blasthole (c), the hole is charged (d) with either AN-FO only (e) or with a LFB dynamite bottom charge and an AN-FO pipe charge (f).

Thus, the three main problems have been overcome.

How AN Cut Underground Blasting Costs at the Boliden Mines

ULF HENNING

BLASTING COSTS in underground mines can be lowered substantially by the use of AN-fuel oil mixtures. Most of the dynamite can be replaced in larger blasting operations by using a pneumatic loading unit, in small blasting operations by using cartridged AN.

At the Boliden mines, in Sweden, about 50% of production is presently blasted with AN-fuel oil mixtures. Holes down to 1-in.-dia can be blasted with good results and wet holes can also be blasted by using a simple technique—blowing the mixture into plastic bags in the hole.

Initial studies at Boliden found the cost-savings potential to be significant: The price of LFB dynamite is 2.15 Kr per kg (13.56¢ per lb). The price of AN-oil mixture is 0.55 Kr per kg (3.49¢ per lb). The company has a yearly consumption of 700 tons explosive. Thus, if the costs for handling and loading the two explosives are the same, and 75% of the dynamite can be replaced by AN-oil mixture, this amounts to a saving of 840,000 Kr ($117,600) per year or 0.33 Kr (4.62¢) per ton of ore produced (based on a yearly production of 2.5-million tons).

Boliden Mining Co. now has 17 mines in production in northern and middle Sweden, most of them on complex sulphide ore, with a total output of about 2.5-million tpy. The mines are scattered over a wide area and the varying conditions necessitate many different mining methods. Those most commonly used are horizontal cut-and-fill, room-and-pillar and sublevel stoping.

After Boliden became interested in AN underground, it conducted a research program that arrived at the following conclusions:

1 Holes down to 1-in. diameter can be blasted with good results, using a mixture of 94.5% fertilizer grade ammonium nitrate available in Sweden and 5.5% fuel oil.

This article is abstracted from a paper titled "Blasting With Ammonium Nitrate Fuel Oil Explosives Underground at Boliden," which was presented at the International Symposium on Mining Research, Rolla, Mo., Feb. 22-25, 1961. The author expressed his appreciation to Boliden Mining Co. for giving permission to present the paper and credited Boliden, AB Agentor, manufacturer of the loading units, Kungliga Arbetarskyddsstyrelsen, Swedish Workers' Protection Board, and other Swedish companies with developing the present blasting techniques.

2 Proper mixing of AN and oil ensures that no hazardous amounts of toxic fumes are to be feared.

At Boliden, the advantages of mixing FO and oil at the face were considered to be predominating; thus, research work went on mainly along this line. However, to replace dynamite in places where a mixing-loading unit cannot be economically used, e.g., small blasting operations; cartridge AN was also tried.

Comparison of AN fuel oil and dynamite was first made by a series of field tests. Later, the use of AN in production blasting confirmed the previous conclusions:

1 Compared on a weight basis, 1 Kg of AN is about equal to 1 Kg of LFB.
2 For AN, there seems to be an optimum loading density at about 1.10g per cc.
3 This density is usually achieved when loading with a pneumatic loader.
4 The loading density of LFB loaded with a tamping pole is usually as low as approximately 1 g per cc. In that case, it can be replaced by AN without altering blasthole spacing.
5 When a pneumatic loading device is used with the LFB ,a density of 1.3 g per cc can be achieved. In this case, AN would be inferior. However, the maximum strength of the explosive is usually only needed in the bottom charge. Therefore, the rest of the hole can be filled with AN.
6 Also, if a stronger type of explosive than LFB was used previously, one can proceed in this way: Keep the strong explosive as a bottom charge and fill the column load of the hole with AN.

Blasting with Mixing-Loading Units at the Boliden Mines

Different types of mixing-loading units have been constructed and tried in close cooperation with the manufacturers, AB Agentor, Stockholm. Common to all these types is that they consist of a steel mixing drum and a loading pipe of plastic hose. AN and oil are charged into the drum and thoroughly mixed. Then, the drum is closed and compressed air conducted into the drum. The compressed air presses the mixture through the loading pipe and the hole is filled from the bottom.

For mixing, most of the units tried were fitted with a mechanical agitator, driven by a compressed air motor. Recently, a new type has been brought into use, which gives proper mixing pneumatically. This development has reduced the weight of the units and made them more simple in construction and more reliable in operation.

Ammonium Nitrate

Provider	Stockholms Superfosfot Fabriks AB, Ljunga Verk
Type	K 2, fertilizer grade
Structure	Fine grained crystalline
Particle Size	15% > 40 mesh (ASTM)
	50% 60 "
	15% 65 "
	10% 100 "
	10% < 100 "
Coating	Organic, no inert materials
Bulk density	Approx. 1.10 g/cm³

LFB Dynamite

Provider	Nitroglycerin AB Gyttorp
Type	LFB
Nitroglycerin-glycol content	36%
Detonation rate	6000 m per second
Explosion gas volume 0°C, 1 atm	855 l per kg
Max. bulk density	1.45 g per cc

A loading crew usually consists of 2 men: one operating the loader, the other handling the loading pipe. That there is still much room for improvement in the efficiency of the loader can be seen from the varying loading performances. When loading 15 to 25-m long, 2-in. blastholes in sublevel stoping during a period of one month (13,500 kg AN), an average performance of 195 kg per man shift was achieved. The corresponding performance when loading LFB dynamite is about 150 kg per man shift. However, during shorter periods of AN loading, considerably higher performance has been achieved: for example, during a time study, two men loaded 625 kg of AN in 4.75 hours. Loading time included, transport of AN, blowing out the blastholes, mixing, filling the blastholes with AN to within 3 m of the top, putting in the primer and filling the rest of the hole with AN. It is hoped that, in the future, performances of the same class will be considered normal. Before that can happen, however, both equipment and loading technique must be considerably improved.

Blasting with Cartridge AN

While the mixing-loading units offer many advantages, their use at least for the immediate future is restricted to bigger blasting operations and places to which the units can be transported without difficulty. To develop a small and simple loader that can easily be transported by one man even in narrow places is a task for the future. Until then, cartridged AN could possibly be used.

However, cartridged AN has two disadvantages:

1 The cartridging adds a considerable amount to the total cost. To decrease this cost, a rationally operated cartridging plant will be necessary.
2 The degree of blasthole filling is rather low.

Since it was doubtful whether a stable detonation could be achieved in spite of the filling degree, a blasting test was arranged. This test involved blasting of 1¼-in. holes, 8 ft long, charged LFB dynamite and AN cartridges with varying diameter.

The AN was cartridged in plastic tubes with 0.15-mm walls and with diameters of 23, 28 and 30 mm and lengths of 400 to 500 mm. The tubes were filled with AN using a mixing-loading unit of the type described above. The stiffness necessary for trouble-free loading was achieved by vibrating the cartridges. Thus, a density of 1.25 to 1.35 g per cc was achieved. A primer of 2 to 3 sticks of LFB dynamite was used (1 stick =80 g), usually placed in the bottom of the hole and thoroughly packed with a tamping pole. The following results were obtained.

1 When 28- and 30-mm cartridges were used, and the blasthole was packed with a loading degree of approximately 1.30 g per cc, the detonation stopped in 3 of 6 holes fired, leaving parts of the hole fully packed with non-ignited AN.

2 Using the 23-mm cartridges and packing them only slightly in the blasthole, a satisfactory detonation was achieved. In these holes the average packing degree was about 0.9 g per cc. With a bottom charge of three sticks LFB dynamite and the rest of the hole loaded with AN and some stemming material, a 1-m burden could be broken.

3 AN compared with dynamite gives a markedly smooth blasting effect. A primer of 2 or 3 sticks of dynamite may be placed in the middle of the hole or in the bottom. Summarizing the results, it can be stated that 23-mm cartridges of AN with a density of about 1.25 g per cc in the cartridge can be used with good result in 1¼-in. holes. To break a maximum of burden, the primer of high strength explosive should be placed as a bottom charge in the hole.

Before cartridged AN can be introduced in the actual mining operations in the Boliden mines, the problem of filling the cartridges with AN at a low cost must be solved.

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2. Hoberstorfer, G. G. and Pousette, I., *Developments in Ammonium Nitrate/Fuel Oil Blasting Underground at Boliden.* MINE AND QUARRY ENGINEERING, June 1960.

See above papers for a more complete list of references.

"W" Group Drill Rods Cut Diamond Core Drilling Costs

Relationship Between "W" Group and "Old Series" Rods

Hole Size	EX		AX		BX		NX	
Drill rod size	E	EW	A	AW	B	BW	N	NW
Hole diameter, in.	1 1/2	1 1/2	1 15/16	1 15/16	2 3/8	2 3/8	3	3
Drill rod diameter, in.	1 5/16	1 3/8	1 5/8	1 3/4	1 29/32	2 1/8	2 5/8	2 3/8
Hole area, sq in.	1.77	1.77	2.95	2.95	4.43	4.43	7.07	7.07
Drill rod area, sq in.	1.35	1.48	2.07	2.41	2.85	3.55	4.43	5.41
Area of space between drill rod and hole wall	.42	.29	.88	.54	1.58	.88	2.64	1.66
Relation between area of space between drill rod and hole wall to area of hole in %	23.6	16.4	29.8	18.3	35.3	19.8	37.4	23.4
Bore of rod coupling, in.	7/16	7/8	9/16	5/8	5/8	3/4	1	1 3/8

*A complete outline of present diamond drilling standards is set out clearly in DCDMA Bulletin No. 2, copies of which are available from either the Diamond Core Drill Manufacturers Association or any of the manufacturers.

ROBERT E. DAVIES

EXPLORATION COSTS are being lowered substantially by the new "W" group diamond drill rods. Mining companies and contractors report faster drilling and lower bit costs wherever they are used.

Basically, "W" group rods are a new group of four sizes of diamond core drill rods—EW, AW, BW, and NW—designed to be used with EX, AX, BX, and NX diamond bits and equipment.

For many years, E, A, B, and N rod sizes were generally accepted. However, in an effort to increase rigidity, reduce vibration, improve rod life, and obtain a more even flow of water, the Diamond Drill Mfg. Assn., (U.S.) and Canadian Diamond Drilling Assn. made tests on two newly designed types of rods, and out of these two types evolved the "W" group. This development was introduced to the industry in the fall of 1955. In naming this new group, the letter "W", which stands for "world", was chosen to denote the ultimate goal of standardization on a world-wide basis. Five years of wide use have shown that these rods have performed beyond expectations.

Increased Rigidity. The substantial increase in the diameters of the rod over the "old series" has provided greater rigidity in the drill string. "Bowing" and "bending" are no longer serious problems, and holes have a lesser tendency to deflect. Recently, on a deep-hole drilling project in N. C., where AX core barrels and A rods were in use, hole deflection was a serious problem until AW rods were introduced.

The increased rigidity is also responsible for longer rod life. Since the problems of hole deflection, whip in the drill string, or bowing are substantially reduced, there is a corresponding reduction in the friction between the rods and the walls of the hole, thus reducing rod wear. The durability of "W" rods is proved by the records kept on a group of AW rods. They were first used on a series of holes averaging 2000 ft in depth in very hard rock. At the completion of the job, 100 of these rods were transferred to an underground project. After a total accumulation footage of 39,372 ft, the rods were examined and found to be in excellent condition.

Reduced Vibration. This is the most important advantage of the "W" rods since this factor favorably affects (1) diamond bit life and (2) machine life.

Outside of labor, diamond bits are the most expensive factor in diamond drilling, and "W" rods can favorably affect diamond bit costs. On a job in the Mesabi range, new NW rods were substituted for relatively new N rods. The footage drilled per bit jumped approximately 20%, and the bit costs dropped.

When wear in the machine chuck of a 1¾-in.-dia routing tool caused serious vibration, the 1-in. portion of the tool used in the actual routing, or cutting, operation had fewer fractured diamonds than the rest of the 3½-in., bortz-set section which saw absolutely no cutting service.

Vibration is one of the causes of machine wear and breakdown. Although the cost of machine repair is a major factor, "down time" and lost footage during periods of breakdown are even more important. A close check of drilling projects on which "W" rods were used has indicated a considerable reduction in machine repairs.

Improved Flow of the Drilling Fluid. Better flow characteristics contribute to: (a) better discharge of the cuttings, (b) better core recovery and (c) reduced danger of caving.

The couplings on "W" group rods have a large bore to permit delivery of a more even flow of fluid to the face of the bit. The increased inside diameters of "W" rods reduce the pressure loss due to friction. In addition, the decreased annulus between the rods and the wall of the hole contributes to a higher annular fluid velocity for a given volume of fluid pumped, resulting in more efficient removal of the cuttings from the hole. An even fluid flow and reduced vibration combine to reduce the jetting and caving of troublesome formations.

On a recent mud drilling project near Hibbing, Minn., caving and poor core recovery were serious problems. When the velocity was increased to satisfactorily wash cuttings from the hole, there was serious erosion of the core. After numerous procedural changes, the N rods were replaced by NW rods. Caving ceased to be a major problem, and there was immediate improvement in core recovery.

Quicker Coupling and Uncoupling. An improved thread design on all sizes of "W" rods makes coupling and uncoupling of the rods faster and easier. In addition, both the BW and NW sizes have three threads per inch as compared with five on the "Old Series" "B" and four on the "N."

Standards of the Diamond Core Drill Manufacturers Association, Bulletin No. 2, covers "W" group drill rods and couplings, core barrels, casings, casing shoes, bits and reaming shells. They also include nomenclature and the dimensions needed to specify standard and interchangeable equipment. Copies of Bulletin No. 2 can be purchased from the Diamond Core Drill Manufacturers Association, 122 E. 42 St. New York 17, N. Y. The price is $1.00 per copy.

Mr. Davies is with Sprague & Henwood, Inc.

US RUBBER ANNOUNCES

WEATHERGARD

THE NEW, MORE DURABLE CONVEYOR BELT COVER

Now makes superior Ozone Resistance a Standard Feature of all U. S. Giant® Conveyor Belting

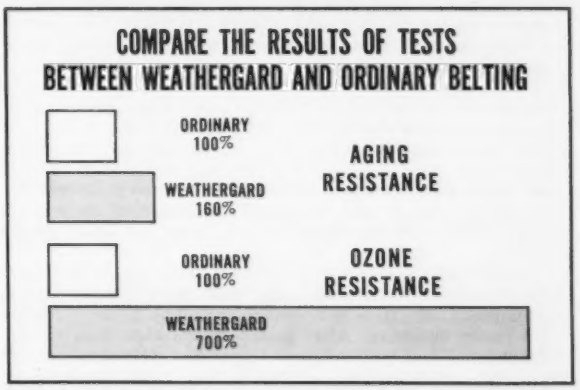
United States Rubber Company has achieved its position as the leading authority in Conveyor Belting through the many "firsts" it has made in this field. Now US brings another major development to Conveyor Belting—the WEATHERGARD cover.

In recent tests, the new WeatherGard cover for Giant Conveyor Belting was subjected to seven times the ozone torture that causes ordinary belt covers to crack and, in turn, fail. The WeatherGard did not crack nor did it give any indication of cracking even after these exhaustive tests.

Further pointing out the toughness and durability of the WeatherGard were tests that showed it to have a substantially greater resistance to cracking from accelerated aging.

In addition, the WeatherGard cover resists damage from smog, sunlight, and weather checking. And . . . besides protecting against these factors that cause ordinary belts to fail, U.S. Giant with its WeatherGard cover is abrasion and wear resistant.

The new WeatherGard cover is standard on all U.S. Giant Conveyor Belting at no extra cost. See your US Representative or Distributor.



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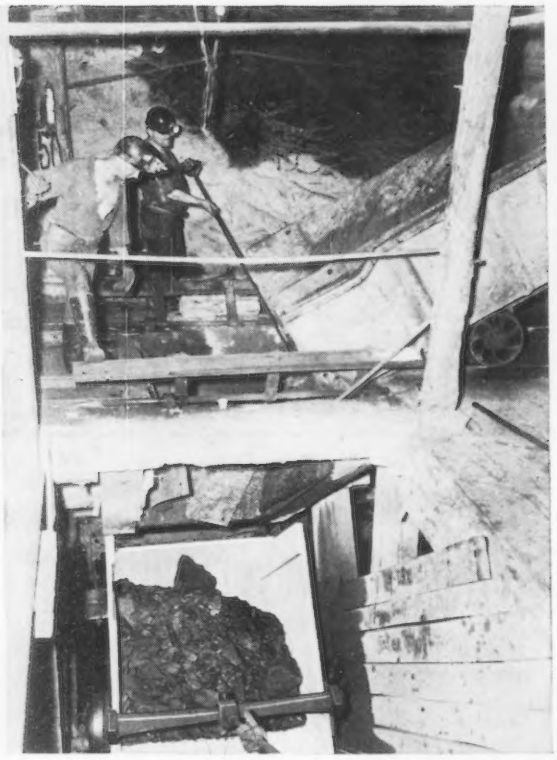
OPERATING IDEAS



BOTH abrasive wear and weight were reduced on this mine skip by changing to shock-absorbing, rubber-faced steel plate.

MOLDED-RUBBER railroad car liner absorbs impact and prevents corrosive mine water from contacting metal cars.

WHEN car is dumped, liner pulls away from bottom but falls in place when car is righted; assuring that all ore is dumped.

Rubber-Faced Plate Cushions Impact, Reduces Costs

MANY MINES are reducing maintenance costs and downtime by the use of rubber-faced steel plate to combat abrasion. Rubber resists abrasive wear better than steel in most applications, but steel is needed for structural strength. The trick is to combine rubber and steel in an economical, usable form, such as by rubber bonded to steel plate.

According to Gates Rubber Co., both abrasive wear and weight can be reduced with rubber-faced plate. For example, an ore skip at a copper mine was originally lined with ⅝-in.-thick steel wear plate. When this plate was replaced with rubber-faced steel plate, the weight of the skip was greatly reduced and power costs were less. Not only has the new plate outlasted the old, but by absorbing much of the impact of the ore, the rubber-faced plate has stopped misalignment and wheel bearing failure.

A railroad car loader at a southern mine screens and loads 50 cars of material per day. Originally the 1-in.-steel loading chute lasted only three to five weeks, resulting in costly crusher and loader downtime. After the chute was lined with rubber-faced plate, it lasted five times longer and downtime was cut from ten shut-downs per year to two. The cost of repair materials was one-third of previous costs.

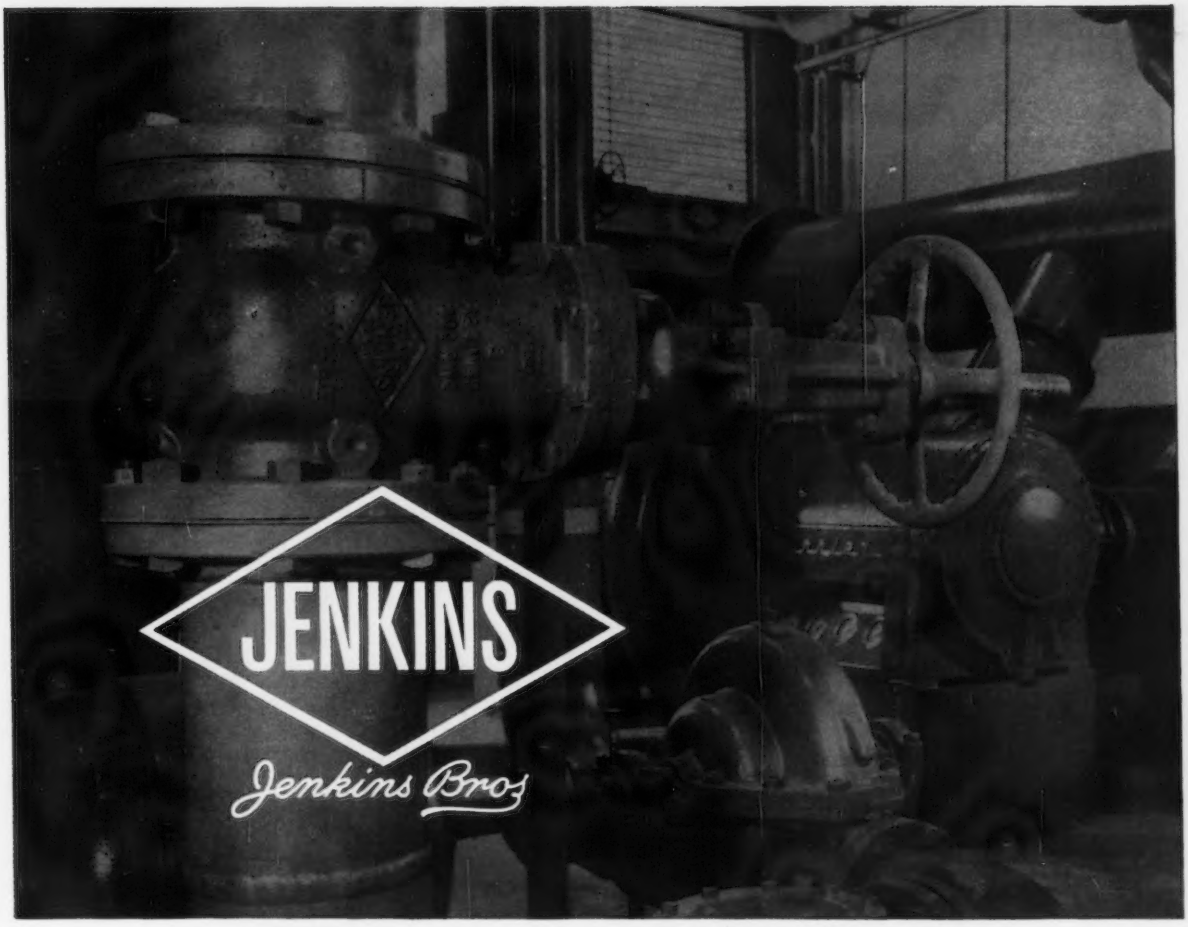
In a mine in Missouri, steel pipes carrying an abrasive concentrate in water wore out every two weeks. As a result, the pipe was replaced by an open-top, trough-type chute lined with rubber-faced plate which has lasted six months with no appreciable wear. Maintenance costs have been reduced $20 per month by this one application alone.

In some cases, rubber-faced plate with 16-gage steel provides enough strength so that launders can be fabricated from rubber-faced plate as a construction material without additional reinforcement.

Rubber without steel-plate backing is also widely used in mining. Ore car liners molded of rubber absorb some of the loading impact and precent corrosive mine water from contacting metal cars. When a car is dumped, the liner pulls away from the bottom of the car insuring that all the ore will be dumped. When the car is righted, the liner falls into place. One man, who formerly cleaned out ore sticking in the cars, has been released for other work.

A steel shute at a midwest mine wore out in six months. A chute made of rubber-faced plate, formed on the job from one sheet, has lasted two years, giving a yearly saving of $375 per chute.

Rubber-faced plate is generally available from stock in several thicknesses of rubber (¼-in. to 1-in.) bonded to 16 or 20-gage steel plate and in sheets up to 48 x 144 in. The sheets can be cut, bolted, welded and formed with standard tools. The 20-gage material can be cut by hand shears and easily bent to shape.



The Sign of a Real Bargain in an IRON BODY GATE

Cost-Per-Year is Lower... Initial Cost no Higher

For generations extra-quality, extra-stamina Jenkins Iron Body Gates were regarded as the best buy for the money . . . even though they cost more to buy. Lower maintenance expense and extra years of service more than offset any price differential.

Today, these widely favored valves are an even bigger bargain in true value. *You pay no more for them at the start!* And you get exactly the same high quality and perfection of design for your money.

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OPERATING IDEAS *(Continued)*

SPECIAL FLASHGUN, which throws a 3-in.-wide band of light on a drift, was developed to photograph drift convergence.

PROFILE photos, when taken with a conventional reflex camera at a set station, can be compared for convergence.

Bureau of Mines Develops Flashgun for Profile Pictures

A SPECIAL FLASHGUN for taking sequence profile pictures in mines has been developed at the Spokane office of mining research of the U.S. Bureau of Mines.

The unit was developed by John McWilliams, former acting chief of the Spokane office who recently was transferred to the Minneapolis office, and Galen Waddell, mining methods research engineer.

It uses components from a conventional flashgun (Rolleiflex). Two 14-in.-dia aluminum discs, spaced ½-in. apart are attached to the front of the flashgun instead of the conventional reflector. A 1½-in. hole through the center of the discs permits insertion of the flashbulb (No. 5 or Press 25) and a wooden cap fits over the hole in the outer disc to insure that all light is reflected to the side.

Bureau research men use a conventional reflex camera (Rolleiflex) with the flashgun to get a circular picture of a drift. Pictures taken at the same point over regular intervals show comparative movement. The flashgun throws a band of light up to three inches wide on a typical drift. The unit has been tested at the Hecla Mining Co.'s Star mine near Burke, Idaho. Holes in the outer disk, about ⅛-in. in diameter, are used to check alignment of the pictures. Officials of the Spokane office feel the new flashgun will be a useful tool in photographing underground mine operations.

Here's how the unit can measure convergence. Assume a picture is taken of a drift from a set point. The picture will show a white band with a measurable width at a measurable distance from the picture's center. Both measurements are a function of the size of the drift and the distance of the band from the camera. Should the drift size change, a picture taken at a later time from the set point will show the light band in a different position relative to points on the drift. Thus, convergence can be determined.

Anaconda Builds Sound-Barrier Fence at Berkeley

A SOUND-BARRIER fence, designed to deaden and deflect the noise of trucks and heavy equipment, has been completed along a section of the east side of the Berkeley Pit in Butte.

The fence, costing approximately $13,500, was erected by the Anaconda Co. at the request of residents of Meaderville and McQueen Additions, sections of Butte near the pit. That the fence is effective in controlling noise is shown in tests made by the company.

"We have found that the fence absorbs much of the sound and bounces some more of it back into the irregular surfaces of the pit where it is largely dissipated," said John W. Warren, Anaconda's chief ventilation and industrial engineer. "We have succeeded in reducing the sound to a very marked degree."

Several months ago, the ventilation department was assigned to cope with the problem. Several studies concerned with sound level readings and types of fence that would be effective were made.

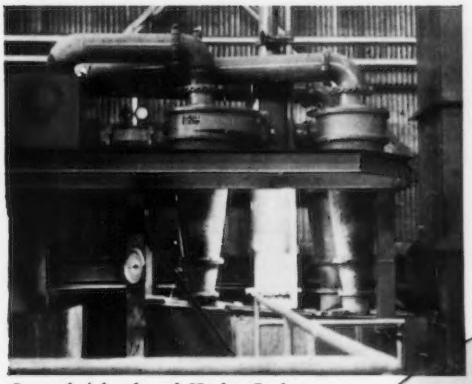
Constructed initially was a 108-ft section of straight fence, 16-ft high and with a 6-ft overhang to serve as a sound trap. Then a 100-ft section of pleated fence was built and further tests conducted.

Now a straight fence has been extended from these two experimental sections, running northward for a total of about 900 ft to the vicinity of Colussa St. where it joins a berm, or highwall of waste. The berm, created with several thousand tons of waste taken from the pit and put in position along the edge of the pit's eastern haul road, runs several hundred feet along the boundary of the pit. Its purpose also is to serve as a sound barrier and an extension of the fence.

The fence has about 20,000 board feet of lumber, exclusive of poles and braces. Supporting poles, of which 90 are used, are standard 25-ft utility poles sunk to a depth of six to eight feet.

Along with the fence and berm project the company has surfaced the main roads in the pit with crushed slag to eliminate as much dust as possible.

Each KREBS CYCLONE handles 2,050,000 tons of primary ball mill discharge with *Original liner!*



One of 4 banks of Krebs Cyclones (4 in each bank) in primary closed-circuit grinding operation at Silver Bell unit of American Smelting and Refining Company.

Krebs Cyclones are equipped with specially designed replaceable liners. Rubbers liners of pure gum or Neoprene are molded under extremely high pressure. This technique eliminates internal porosity, resulting in a rubber of greater density without reducing the resiliency. Correct fit of the liners is assured, and a smooth glassy surface is maintained for superior performance during the greatly extended wear life. Wear increases toward the apex of the conical section and for very abrasive slurries the lower cone and apex section are frequently lined with Refrax or other special material.

Detailed operating and metallurgical report of this operation are available upon request to Equipment Engineers Inc.

EQUIPMENT ENGINEERS INC.
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PERSONALS

Jesse Charles Johnson, director of the Division of Raw Materials of the U. S. Atomic Energy Commission, has been selected as the third recipient of the Ambrose Monell Medal for distinguished achievement in mineral techology.

In addition to the gold medal, which was established at Columbia University in 1954, Mr. Johnson also will receive the first Ambrose Monell Prize of $25,000 from the Ambrose Monell Foundation.

Johnson was born in Clallam, Washington, and received his Bachelor of Science degree in Mining Engineering and Geology from the University of Washington in 1919. He practiced as a consulting mining engineer in Seattle for a number of years, and since 1942 he has been in government service, first as an engineer, then chief engineer and deputy director in charge of domestic and foreign metal procurement with the Reconstruction Finance Corporation.

In 1948 Mr. Johnson joined the U. S. Atomic Energy Commission as deputy director of the Division of Raw Materials, and became director of the division in 1950. He has received many honors, including the distinguished service award of the Atomic Energy Commission, and the chemical engineering award of the American Institute of Chemical Engineers.

The Division of Raw Materials, under his direction, has ben credited with developing the expansion of uranium resources available to the United States, introducing advanced techniques responsible for the extraction of uranium ore in the United States and Canada, as well as in the original large producing areas in the Belgian Congo and the Union of South Africa.

During his career Mr. Johnson has been adviser to the United States Delegation, International Tin Conference, in 1946; adviser to the United States Delegation, International Conferences for Peaceful Uses of Atomic Energy, Geneva, in 1955 and 1958; and chairman of the International Conferences on "Uranium Resources and Possibilities" in Buenos Aires in 1960.

Thomas I. Moore has been named vice president and manager of the Monsanto Electrolytic Division, having worked for the company at the Columbus, Ohio; Fairmont City, Ill.; Dumas, Texas; and Monsanto, Ill. plants since his graduation from Ohio State University with a Degree of Bachelor of Mechanical Engineering in 1934. While attending high school and college he was employed by the company during summer vacations.

He has filled the position of plant engineer, assistant general superintendent of the Electrolytic Division from 1941 to 1956, and general superintendent from 1956 to 1959. Since 1959 he has been Manager of the Electrolytic Division at Monsanto.

Theodore B. Counselman, consulting metallurgical engineer and secretary-treasurer of Behre, Dolbear and Company of New York City, has been awarded Columbia University's Alumni Medal for "service of exceptional merit" to the University and to School of Engineering of which Mr. Counselman is a graduate in the class of 1910. The medal will be presented to Mr. Counselman by President Grayson Kirk on Commencement Day, June 6, at Columbia University.

Counselman retires this year from the presidency of the Columbia Engineering School Alumni Association which he has served in various capacities for a number of years, the last two as president. In addition he is member of the Columbia Engineering Council, advisory body to the Columbia School of Engineering, and a director of the Columbia Alumni Federation.

Counselman's engineering career began with sulphur exploration in Texas, continued with the Consolidated Copper Company in Arizona, and he was concerned with the magnetic taconite development of the Mesabi Iron Company in Minnesota. For 28 years he was a member of the Dorr Company, concerned with iron ore benefication, cement manufacture, chemical processes and fluosolids roasting equipment.

Counselman has been a member of the American Institute of Mining, Metallurgical and Petroleum Engineers for 47 years, having served as Chairman of the Chicago and New York sections of the Society; Chairman of the National Membership Committee; blast furnace and raw materials committee, Iron and Steel Division; and as a director and member of the Executive Committee, as well as Vice President of A.I.M.E.

Jack W. Buford has been advanced to the newly-created post of Manager of South American Operations, Hanna. He will also continue as Assistant Vice President, Operations.

Busford will be responsible for all Hanna development and operations in South America. The company's activities include the potential development of a large reserve of high grade iron ore in Brazil and the study of other mineral deposits in South America.

He joined the company in 1950 and took a key role in the development of the large Quebec-Labrador iron ore fields of Iron Ore Company of Canada, in which Hanna has an interest.

A native of Topeka, Kans., Buford was graduated from the University of Washington in 1933. He earned his Master of Science Degree at Harvard the following year.

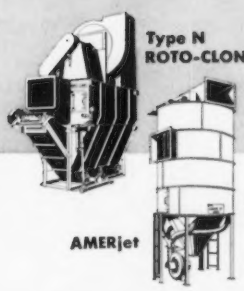
Earl S. Mollard, general manager of Oregon operations for the Hanna Mining Co. and the Hanna Nickel Smelting Co. since 1953, has been appointed vice president, mining operations, of Hanna Mining Co. and general manager of mines for the M. A. Hanna Co. The two companies operate properties in Minnesota, Michigan, Missouri, Oregon and Ontario.

Mollard joined the former Butler Bros. in 1923 and advanced to manager of mines for that company at their Cooley, near Nashwauk, properties. In 1948 the Butler Bros. operations were taken over by the M. A. Hanna Co. and Mollard was made assistant manager of mines under R. W. Whitney, manager. He remained in this position until transferred to Oregon in 1953.

George E. Kruger has been promoted to vice president by the Chase Manhattan Bank, New York. Kruger joined the bank in 1957 as a mining geologist in the petroleum department and was named technical director, mining industry, in 1960. Prior to 1957 he was a consulting mining geologist in South America and in New York.

He is a member of the American Institue of Mining, Metallurgical, and Petroleum Engineers, the Geological Society of America, the Society of Economic Geologists, and Sociedad Geologica del Peru.

How AAF Licked the URANIUM Dust Problem



Twelve uranium mills now rely on AAF Dust Control equipment

When pioneer operators found that dust from uranium processing assayed as much as *seven times* richer than the ore itself, they knew they couldn't afford to "experiment" with dust collectors. Logically, they turned to AAF.

AAF has been salvaging uranium dust since 1940. Now a dozen uranium mines are using AAF collectors to reclaim this dust and keep operations clean. The AMERjet fabric dust arrester is a favorite for this service, especially where dust must be collected *dry*. AAF's wet-collecting Type N ROTO-CLONE does the job in another way . . . produces a slurry of uranium-rich material. *Both do the job well*—better than 99% efficiency!

Take a tip from uranium—call your AAF representative or write direct for AMERjet Bulletin 279 and Type N ROTO-CLONE Bulletin 277. Address: Mr. Robert Moore, American Air Filter Company, Inc., 193 Central Ave., Louisville 8, Ky.

AAF American Air Filter
BETTER AIR IS OUR BUSINESS

Merle H. Guise, exploration engineer with headquarters at Palm Springs, Calif., has been examining beryl properties in the Lake George district of Colorado, after some beryl prospecting in Arizona.

Jack H. How, president of Western Machinery Company, headquarters in San Francisco, has been elected to the Board of Directors of Arthur G. McKee and Company of Cleveland, Ohio.

Western Machinery Company, whose operations are conducted by its Western Knapp Engnieering Co. and WENCO divisions, became a wholly owned subsidiary of McKee in January, 1961.

The WKE-McKee combination provides world-wide engineering and construction services to the minerals processing, iron and steel, petroleum, and chemical industries, and is one of the largest and most diversified organizations in its field of activity. The WEMCO division manufacturers and sells materials processing and handling equipment to the minerals, aggregate, coal, and sanitation industries.

Charles E. Bartlett, resident manager for Reynolds Metals Company's bauxite producing operations in British Guiana, is currently in the United States on biannual leave.

Bartlett expects to return to British Guiana about mid-June.

Arnold E. Hill, superintendent of the Holman-Cliffs mine at Taconite, Cleveland Cliffs Iron Co., has been transferred to the Empire mine on the Marquette range in Michigan as superintendent. The Empire is a new, low grade iron property under development.

Charles D. Borror Sr., production engineer, Asbestos Fibre Division of Canadian Johns-Manville Co., Ltd., Asbestos, P.Q., has been appointed manager of Coalinga Asbestos Co. in California.

Born in Penfield, Ill., and a graduate in Mining Engineering and Geology from the University of Illinois, Borror saw overseas service with the U.S. Marine Corps during the first World War. He joined Canadian Johns-Manville Co., in May 1928 as mining engineer at Jeffrey Mine in Asbestos, P. Q.

During his 33 years of service with Canadian Johns-Manville Co., Ltd., Borror has filled the following responsibilities: mining engineer, assistant mine superintendent, mine superintendent, chief engineer, plant engineer and technical assistant to the Jeffrey Mine Manager.

Since August 1952, he has held the position of production engineer for the Asbestos Fibre Division, with the added responsibility of liaison between the General Manager and the Advocate Mines Limited management on all mining construction problems.

E. R. Rantala, Coleraine, engineer at Cleveland Cliffs Iron Co.'s Canisteo mine, has been transferred to the Cliffs' district office in Hibbing.

George T. Beardshear, who had been with the Pittsburgh Pacific Co. in Crosby, is now at Casper, Wyoming, with the Tidewater Oil Co.

S. F. Thompson, Elliot Lake, Ontario, is now head of the mechanical department of Steep Rock Iron Mines, Ltd.

John F. Linden, Hibbing, district superintendent of Jones & Laughlin's west Mesabi range mines, has retired, and will make his home in Hibbing. He joined the company in 1941 as a pit foreman at the Hill-Annex mine in Calumet. Later he became superintendent of the Longyear mine in Hibbing. In 1947 he was appointed district superintendent, the position he held when he retired. He was succeeded by Archie Mc Williams of Gilbert.

Carl W. Anderson, Iron River, district electrical engineer for the M. A. Hanna Co., has been transferred to the Cleveland office. He will be asst. to Fred D. Vines, chief mechanical and electrical engineer. His work will cover all of the Hanna operations. Mr. Anderson joined the Hanna Co. in 1936. In 1947 he was promoted to electrical engineer for the company's Michigan mines. He will now be located at the Cleveland office.

Clarence H. Sleeman has been appointed assistant to the chief engineer of the M. A. Hanna Co. at Cleveland. He was formerly with the Jones & Laughlin Steel Corp., both on the Mesabi range and at their Pittsburgh office.

Richard C. Cole, Salt Lake City, has been appointed executive vice president and general manager of White Pine Copper Co.

OBITUARIES

Richard F. Norris, 59, Hibbing, died on February 18th. For 17 years he had been manager of the service and parts depot of the Marion Power Shovel Co. on the Mesabi range. He had been with the Marion Co. for more than 30 years.

Paul W. Kruse, 64, of Virginia, Minn., died on February 20th. He had been with the J. & L. Steel Corp.'s Minnesota Ore Div. since 1922: as an engineer at the Hill-Annex mine at Calumet; as superintendent of the Columbia mine in Virginia, and as district superintendent of the company's eastern district, which position he held last. He was a World War I veteran and a former commander of the Marble, Minn. American Legion Post.

Arthur E. Carleton, 65, of Hibbing, died in California. He was a mining engineer with the Cleveland Cliffs Iron Co. and a former mayor of Hibbing, in 1952. He had been with Cleveland Cliffs since 1945.

J. Fred Markwell, 93, a pioneer northern Idaho mining man who helped develop the Hercules mine near Burke, Idaho, died April 10 at his home in Spokane.

He was born in Wyoming and started his mining career in 1889 at Wallace, Idaho. The same year Markwell joined with his son, Alexander Markwell, and with Harry L. Day, C. H. Reeves, August Paulsen and L. W. Hutton to develop the Hercules claims located near Burke.

The partners struck pay dirt after several years of work and eventually the property produced $75,000,000 worth of ore which netted about $20,000,000 for the venture. The lead, silver and zinc property was prominent in the early development of the Coeur d'Alene mining district of northern Idaho.

Markwell later developed the Star Mining company.

He had studied mining engineering and geology but was a salesman for his father's dairy in Wallace when he went into the mining business.

Cecil A. Fitch, 75, a co-founder of the famous "Chief" mine in Utah's Eureka District, died April 16 at Salt Lake City.

Fitch, who was president of Chief Consolidated Mining Co. from 1937 to 1956 participated with his father and brothers in development of mining properties in the Eureka district which in 1909 were organized into the Chief Consolidated.

He was a native of Beacon, Mich., and received a Master's Degree from Michigan College of Mines in 1908. He was a member of the Catholic Church and was given the honor of Knight of St. Gregory by Pope Pius XII.

Carl Otto Anderson, 65, president of the Ozark-Mahoning Co., died April 13, at Tulsa. Anderson joined Ozark-Mahoning in Baxter Springs, Kans., 35 years ago, coming to Tulsa in 1941. He was in charge of research until becoming vice-president in 1947.

In 1953, Anderson was elected president of the company which has a sulphuric acid plant and research department in Tulsa, sodium sulphate plants in Brownfield and Monahans, Texas, a fluorspar mine in Rosiclare, Ill., and a fluorspar drying plant in Wilmington, Del.

Anderson was a graduate of the University of Kansas and did post-graduate work at the University of Washington. During World War I, he served in the Army's Chemical Warfare Division. He was a member of the American Society of Chemical Engineers and the American Institute of Mining Engineers.

George W. Malone, 70, former Senator from Nevada, died May 19. During his two terms in the Senate, he was known as a militant member of the Republican Old Guard who fought vigorously for isolationism and against foreign aid and trade.

Malone, who received a degree in engineering from the University of Nevada, was chief engineer for that state from 1927 to 1935. He left to act as a consulting engineer, and became adviser to the Secretary of the Interior on the construction of Boulder Dam. During World War II, Malone was called to Washington to act as a consultant to the Secretary of War and the Senate Military Affairs Subcommittee on matters pertaining to strategic and critical minerals and materials.

Malone was elected to the Senate in 1946, where he served two terms. After leaving the Senate in 1959, he returned to Reno where he worked as a mining engineer.

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Profitability? Faced with the decision to expand your plant facilities, you should first determine whether all elements combine to form a pattern of future profitability. Independent analysis of all aspects of your proposed program is the *Pre-Engineering* service offered by Kaiser Engineers. The studies and evaluations furnished by KE Pre-Engineering represent only one phase of total KE services. Kaiser Engineers is an experienced designer and builder of all types of facilities for the Minerals industry. From Pre-Engineering through design and construction, Kaiser Engineers provides complete one-company service and ingenuity based on years of experience.

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WHAT'S NEW IN PATENTS

OLIVER S. NORTH

U.S. PATENTS

Mining

Improved process for underground solution mining of comparatively thick beds of trona which contain insoluble inclusions and contaminating organic matter, e.g. the main trona bed at Green River, Wyo. C. A. Bays, assigned to Food Machinery & Chemical Corp. U.S. 2,979,317.

Metal and Mineral Processing

Design for a multi-stage centrifugal concentrator for efficiently upgrading ores, particularly high-silica iron oxide ores. N. H. A. Rodman and A. Arbetman, assigned to Oreclone Concentrating Corp. U.S. 2,976,994 and 2,978,100.

Design for a magnetic separator useful for beneficiating undried ores of iron and manganese. R. C. Forrer. U. S. 2,976,995.

Design for a sluice box for recovering gold or other heavy minerals from sand slurries containing such minerals. The heavy particles gravitate through apertures in the floor of the sluice box, while a gas pressure higher than the ambient pressure on the top of the slurry flowing in the box is maintained on the apertures. T. W. Miller. U.S. 2,976,997.

Improved method of utilizing roaster gases in the roasting of pyrites containing arsenic and/or antimony, whereby the impurity is removed in the gases from a first fluidized layer. W. Pfannmuller, A. Johannsen and G. Whittmann, assigned to Badische Anilin- & Soda-Fabrik A. G. U.S. 2,978,297.

In the recovery of chromium, cobalt, and ferronickel alloys from lateritic ores, such as those of Cuba, New Caledonia, and the Philippine Islands, the major portion of the cobalt and chromium is recovered from the aqueous ore pulp by gravity methods, and the pulp is then treated with an acid to coagulate the suspended iron and nickel, which is separated, smelted, and refined. T. Takakuwa. U.S. 2,978,317.

Combination pneumatic-magnetic concentrator for recovering magnetic iron oxide or other magnetic minerals from mixtures thereof with sands, ores, etc. B. F. Hearn, 49% assigned to H. J. Valentine. U.S. 2,979,197.

In the sodium carbonate leaching of uranium ores, the solubility of the uranium is increased by leaching the ore in a series of tanks countercurrent to the flow of an ozone-oxygen gas stream. R. A. Koble, assigned to Phillips Petroleum Co. U.S. 2,979,378.

In the froth flotation of oxide or sulphide minerals, e.g. iron oxide or copper sulphide ores, which contain calcium carbonate, magnesium carbonate, or other acid-soluble carbonate gangues, the mineral pulp is acidified by introducing therein carbon dioxide until the desired pH value is obtained. Consumption of large quantities of mineral acids is avoided. M. Mortenson. U.S. 2,980,253.

Design for an apparatus for comminuting ores by subjecting coarse ore particles to concentrated and focussed ultrasonic waves. D. K. Kececioglu, R. T. Baugh and T. R. Hoffmann assigned to Allis-Chalmers Mfg. Co. U.S. 2,980,345.

Apparatus and method for pan-sintering ore fines, wherein the pans are handled so that during the sintering operation they are not subjected to bumps or shocks, thereby preventing cracking or shattering of the sinter cake already formed. The sinter stations are disposed one over the other, and each has its own igniter and suction exhaust. R. W. Strang. U.S. 2,980,527.

Copies of U.S. patents can be purchased at 25c each from Commissioner of Patents, Washington 25, D.C.

In the flocculation of iron-ore slimes to accelerate settling of solids in aqueous suspension, the slurry is treated with a combination of hydrated lime and a solution of sodium silicate or other alkali metal silicate. T. A. Johnson, assigned to U.S. Steel Corp. U.S. 2,980,608.

CANADIAN PATENTS

Mining

Method of melting and recovering sulphur from sulphur beds under the ocean but adjacent to the shore, wherein collapse of the surrounding limestone formation does not interfere with the mining operations. A shaft is sunk on shore to below the level of the mineral bed, a working is run to the bed, and a solution mining system is set up, wherein the solvent is injected into the ore bed from below, and the pregnant solution recovered from below. B. Dykstra, assigned to Shell Oil Co. Apr. 11, 1961. Canadian 618,034.

Metal and Mineral Processing

To depress chlorite-talc gangue minerals during froth flotation of sulphide ores of zinc, copper or other metals, the ore pulp is conditioned with guar gum or other mannogalactan gum. R. F. Coulter and D. Raychevich, assigned to General Mills, Inc. Mar. 14, 1961. Canadian 616,256.

In an improved froth flotation process for concentrating nickel, copper, or other metal values occurring in sulphide ores in association with talc, clays, magnesia, silica, and other slimes-forming gangue materials, small amounts of sodium silicate and then guar are added to the ore pulp as a dispersant and a slimes depressant, respectively. R. T. N. Drake, assigned to Sherritt Gordon Mines Ltd. Mar. 21, 1961. Canadian 616,687.

Apparatus and method for opening asbestos fiber bundles and removing dust and short fiber therefrom to produce a textile grade fiber. The bundles are repeatedly subjected to an opening and cleaning action until a desired degree of opening has been attained, and then the fiber is propelled out of the treating zone. I. Barnett, assigned to Johns-Manville Corp. Mar. 21, 1961. Canadian 616,813.

To accelerate the rate of settling of slimes or fines in mineral slurries, the pulp is treated with a soluble polyacrylamide to flocculate and agglomerate the solids. This process is applicable to uranium ore leach solutions, cyanidation tailings, copper flotation concentrates and tailings, hematite ore, and nonmetallics, such as kaolin and other clays, barite, feldspar, phosphate rock, gypsum, portland cement raw materials, asbestos, and others. E. R. Kolodny and R. B. Booth, assigned to American Cyanamid Co. Mar. 21, 1961. Canadian 616,967.

In the production of metallurgical-grade alumina from clay or low-grade siliceous bauxite, the silica impurity is eliminated first by leaching with hydrochloric acid, and then the iron is eliminated by sintering the mixed chlorides and leaching the sinter with an aqueous solution of caustic soda (No. 617,232) or sodium carbonate (No. 617,442) to form soluble sodium aluminate. F. Laist, assigned to Anaconda Co. Mar. 28, 1961. Canadian 617,232 and 617,442.

Copies of Canadian patents can be obtained from Commissioner of Patents, Patent & Copyright Office, No. 8 Bldg., Carling Ave., Ottawa.

To improve the dewatering of mineral pulps or suspensions, such as uranium ore slurries or concentrates of sulphide ores of nickel or iron, a small amount of a tertiary amino alkyl ester of a fatty acid is added to the pulp. The resulting filter cake is relatively dry, friable, and free from surface moisture. M. D. Head, assigned to International Nickel Co. of Canada, Ltd. Apr. 11, 1961. Canadian 618,058.

Mr. North is patent consultant, Washington, D.C.

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NEW BOOKS

Chromium in Southern Rhodesia. A valuable brochure with photographs and maps in four colors compiled by R. Stanley, Minerals Information Officer, Mines Department, Southern Rhodesian Government. Rhodesian reserves of chromite ore are estimated at 608 million tons, of which 50% is metallurgical grade. This territory is the Free World's largest source of metallurgical chromite. Transport bottlenecks in the area have been largely eliminated to assure a steady supply of ore to markets. Copies of this report may be obtained from the Office of the Minister for Rhodesia and Nyasaland Affairs, British Embassy, Washington, D.C. 21 p plus map and folder on the structure of the Southern Rhodesia chrome industry.

Cost Engineering in the Process Industries, edited by Cecil Chilton, Editor, CHEMICAL ENGINEERING, and staff. Major sections include principles of cost estimation, process equipment costs, non-equipment capital costs, plant costs, manufacturing costs, profitability and economic analysis, and other areas of cost engineering. Published by McGraw-Hill Publishing Co. 330 W. 42 St., New York 36, N. Y. 475 p. Price $11.

Aufbereitung der Steinkohle, Erster Teil, Der Deutsche Steinkohlenbergbau, Technisches Sammelwerk, Band 4, edited by Dr. Ing. Werner Hagen and Dr. Ing. G. A. Hermann Meyer. Some 25 authors have contributed to this extensive handbook on the beneficiation of coal by numerous modern processes. The text is profusely illustrated with flowsheets, tables, and equipment drawings, and represents a cross-section of up-to-date technology of coal preparation. Published by Verlag Gluckauf Gmbh, P. O. Box 1794, Essen, Germany. 407 p.

Small Plant Management: A Guide to Practical Know-How Management, second edition, revised by W. A. MacCrehan, Jr. This small plant research study was prepared under the auspices of the Management Division of the American Society of Mechanical Engineers. Published by the McGraw-Hill Publishing Co., 330 West 42 St., New York 36, N. Y. Price $10.50. 563 p.

Oxygen, Section 4, Gmelins Handbuch der Anorganischen Chemie, 8 Auflage. The 4th oxygen section treats the following subjects: Air (157 pages), active oxygen (8 pages) and ozone (200 pages). Published by Verlag Chemie, Gmbh., Weinheim Bergstr., West Germany. Available also at Walter J. Johnson, Inc., 111 Fifth Ave., New York 3, N.Y., and Stechert-Hafner, Inc., 31 East 10th St., New York 3, N.Y. 366 p. Price $53.

Illinois Fluorspar, by G. C. Finger, H. E. Risser, and J. C. Bradbury. An excellent profile of the Illinois fluorspar industry, and of the marketing and uses of fluorspar in the U.S. Published by the Mining Div. of the Illinois State Geological Survey, Urbana, Ill. 36 pp.

Design for Growth. The story of National Gypsum Co., by Dean Richmond. Chapter I starts out with this statement: "This is a story of men of vision and little money who parlayed an idea and a strange rock into a quarter-of-a-billion-dollar industrial enterprise, through charting a course that to many seemed foolhardy when considered by ordinary business standards. That they managed to survive at all is a wonder. That they succeeded in a scant 35 years is a modern-day industrial marvel." The rest of the book tells how National Gypsum Co. built up a volume of sales of gypsum, cement, lime, mineral wool, asbestos, paint, metal, paper, ceramic tile and pyrophyllite products from zero in 1925 to $226,277,806 in 1959. Published by National Gypsum Co., 325 Delaware Ave., Buffalo 2, N.Y., in commemoration of its 35th anniversary. 142 pp.

The following publications pertaining to silicosis are available in reprint form at the McIntyre Research Foundation, Suite 1500, 25 King St. West, Toronto 1, Ontario, Canada:

Theories of the Causes of Silicosis, by G. W. H. Schepers, M.D., Haskell Laboratory for Toxicology and Industrial Medicine, E. I. du Pont de Nemours and Co. 23 p.

Diffuse Fibrogenic Pneumoconiosis, by Arthur Vorwald, professor and chairman, Department of Industrial Medicine and Hygiene, Wayne State University, Detroit, Mich. 6 pp.

BOOKS presented on this page may be obtained directly from the publisher mentioned in each case. E&MJ does not sell books.

Science—the Endless Frontier. This new edition contains Dr. Vannevar Bush's historic report to the President in 1945 on the need of an executive agency of the Federal Government to support basic research in the sciences. So persuasive was his thesis that Congress in May 1950 established the National Science Foundation. The new edition contains a new foreword by Dr. Bush, and a new introduction by Dr. Alan T. Waterman, who has been director of the foundation since its inception. Published by the National Science Foundation, Washington 25, D.C. 220 pp.

List of Publications, Bulletin No. 25, Ontario Department of Mines. Publications available are classified as follows: annual reports and accompanying maps, bulletins, geological circulars, industrial mineral circulars, metal resource circulars, preliminary reports, miscellaneous publications, principal publications by subjects (metal and mineral commodities). Prices for reports, bulletins, geological maps, and other maps are stipulated. Published by the Ontario Department of Mines, Toronto, Ont., Canada. 71 pp plus index map. Price 25c.

Exploration for Heavy Minerals on Hilton Head Island, South Carolina. Bulletin 26 published by the Division of Geology, State Development Board, Columbia, S.C. Exploration by National Lead Co. and U.S. Bureau of Mines disclosed some eight million tons of heavy minerals on Hilton Head Island. 13 pp plus map.

Gunflint Iron Range in the Vicinity of Port Arthur, by W. W. Moorhouse, and **Gunflint Iron Formation of the White fish Lake Area,** by A. M. Goodwin. Published by the Ontario Department of Mines, Toronto, Canada. 67 pp plus 8 maps.

Historical Statistics of Minerals in the United States, compiled and annotated by Sam Schurr and Elizabeth Vogley. Published by Resources for the Future, Inc., 1775 Massachusetts Ave, N.W., Washington 6, D.C. 42 pp. Price $1.

Machine Drawing and Design, by W. Abbott, This book has been rewritten to provide a course in machine drawing and design for students of mechanical engineering who are following university and technical college courses or are preparing for examinations of the professional engineering institutions. Published by Blackie Son, Ltd., 17 Stanhope St., Glasgow, C.4, Scotland. 277 p. Price 21 s.

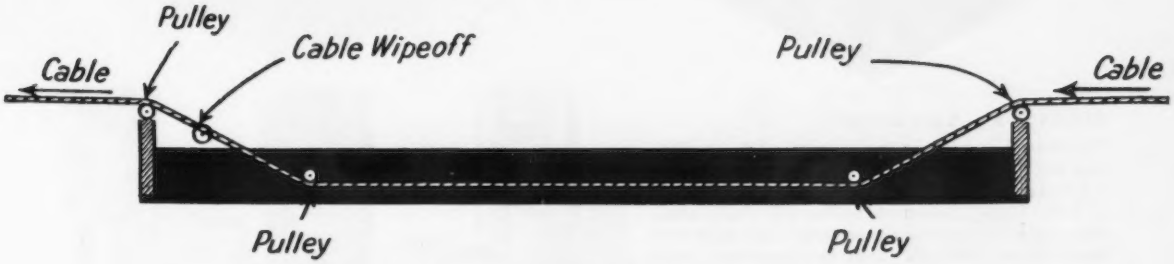
Geologic Investigations in the Kootenai-Flathead Area, Northwest Montana, Part 2, Southeastern Lincoln County, by Willis M. Johns. This bulletin has been prepared by the Montana bureau of Mines & Geology under a cooperative agreement with the Great Northern Railway Co. and the Pacific Power & Light Co. Published by the Montana Bureau of Mines and Geology, Butte, Mont. 52 p plus four maps.

Professional Engineer's Examination — Questions and Answers, by William S. La Londe, Jr. Subjects included in this text are fundamentals, chemistry, science, materials, electricity, mathematics and measurements, hydraulics, mechanics, thermodynamics, civil engineering, electrical engineering, chemical engineering, mechanical engineering, structural engineering, land surveying, engineering economics and business relations. Some 600 questions selected from recent examinations for professional engineering licenses are presented and answered. Published by the McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y. 262 pp. Price $7.50.

Management of Nuclear Materials, edited by Ralph F. Lumb. Specialists describe and discuss the acquiring, recording, evaluating, and presenting of quantity data necessary for the control of nuclear materials in all operations from mine to reactor. Published by D. Van Nostrand Co., 120 Alexander St., Princeton, N. J. 516 pp. Price $16.50.

LUBE LOGIC

2 new ways to trim downtime



Warm bath restores wire rope

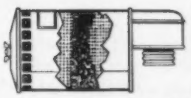
The best way to get lubricant inside a cable, where it's really needed, is to immerse the cable or wire rope every 500 hours or so in a bath of warmed-up Crater A lubricant. It pays off by giving you far longer service life than you would get simply by applying Crater A externally. This warm-bath treatment requires a horizontal trough to hold the lubricant. The trough should be fitted with pulleys to keep the cable completely submerged while it's passing through. A burlap collar should be rigged to wipe off excess lubricant as the cable leaves the box. An immersion of about a minute will allow the lubricant to work well into the strands.

This process is *not* an alternative to other lubrication. You should continue to clean the cable and apply Crater A externally every 10 to 100 hours, depending on the type of work the cable is doing. Remember also to be very sparing with lubricants on cables that wind on clutch-equipped drums, and never lubricate cables that are dragged in dirt.

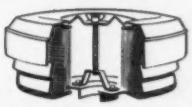
Key points on air filter maintenance

In a day's operation a typical engine inhales several thousand cubic feet of air, and in strip mining all that air is probably loaded with abrasive dirt and dust. Good air-filter maintenance is the only way to make sure your engine gets the air and not the dirt. Here are some maintenance tips that will keep your air filter working harder through thick and thin.

Oil-bath type air filters won't function properly if there's more than a half inch of sediment at the bottom of the oil reservoir. Check the sediment level by sticking a screw-driver down into the oil, and if you're anywhere near the half-inch level, the bowl should be cleaned out and refilled. Also, inspect the filter every 5 to 50 hours to make sure the oil itself is at the right level. Every 500 hours the whole cleaner should be dismantled and cleaned, and refilled with new engine oil of the same grade used in the crankcase.



Wire gauze type filter. If you want to re-use the element, wash the gauze in kerosine or diesel fuel, shake it dry (don't blow it with compressed air) and re-oil it with SAE 40 or 50 oil to coat the element.



Dry type air cleaners (the ones with the fluted paper element) should simply be shaken or tapped lightly to remove dirt, and reinstalled. Never clean dry-type elements with kerosine or diesel fuel.

Additional precautions: empty centrifugal precleaners when the glass container is half full; don't remove the oil cup when the engine is running.

TEXACO LUBRICATION ENGINEERS

Every month or so we'll bring you a batch of "sleepers"—little angles, so easy to overlook, where big savings in time and money can be made. But month in, month out, your local Texaco Man is your best source of money-saving lubrication ideas. Don't forget that "Lubrication is a major factor in cost control." Texaco Inc., 135 East 42nd Street, New York 17, N. Y.

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TEXACO

Throughout the United States
Canada • Latin America • West Africa

DIAMOND BITS *and* CORE BARRELS

SERIES D-3 — Core Barrel*

This barrel is manufactured in EX, AX, BX, NX, and NC sizes. Available in 5 ft. and 10 ft. lengths it takes a core ranging in size from .840″ dia. (EX) to 2.400″ (NC). Incorporates new adjustable bearing assembly permitting vertical inner tube and bearing adjustments. Bearing suspended inner tube prevents core grinding and minimizes core erosion. This barrel is designed to recover maximum amount of core in all types of rock conditions. Tube borium hard faced strips on core barrel head retard abrasion, increase stabilization and extend core barrel life.

SERIES C-3 — Core Barrel*

Increased annulus between tubes and between outer tube and hole allows this barrel to be used with either water, mud or compressed air. Manufactured with heavier wall tubing than conventional barrels for that heavy duty coring job. Includes adjustable bearing assembly and tube borium hard faced strips on core barrel head. Available in standard 5, 10, 15 and 20 foot lengths.** Core sizes range from 1.067″ dia. (AX) to 1.875″ dia. (NX). Because of decreased core size we do not recommend this barrel for coring extremely hard rock.

3-1/2″ x 2-1/8″ Core Barrel*

This barrel is made for use with heavy duty drills. It can be used with water, mud or air and takes a 2-1/8″core. It is available in 5, 10, 15 or 20 ft. lengths. Illustrated is a detachable pilot-type core bit available for this barrel.

**Recommend AX in 5 and 10 ft. lengths only.

*Chrome plated inner tubes available for above barrels upon request.

Christensen manufactures many modifications and adaptations of the above equipment. For detailed information on our complete line of diamond bits and core barrels, write for catalog SD508.

Trouble-free operation — minimum maintenance — maximum core recovery. This is what you buy in Christensen core barrels. Barrels designed for every type operation and every size drill, from small prospector to heavy duty types.

FOR MINING EXPLORATION

The pilot type core bit has proved a most efficient style for core recovery in soft formations and is currently being adapted to many of our core barrels. Tungsten carbide grit hard facing is available.

A step or pilot type non coring bit reduces vibration and increases penetration rate. It is ideal for drilling long straight holes, pilot holes, blast holes, grout holes, drain holes and cement in diamond drill holes.

The casing shoe has box thread (pin thread available), extra hard matrix and 25 per carat size diamonds. Casing shoes are set without inside gage stones to allow a corresponding size bit and reaming shell to pass.

Here is a standard bevel wall impregnated core bit with light diamond concentration. It is designed to overcome the problems of hard, fractured, abrasive and, in general, difficult to core rock. There is no salvage or credit value for returned bits of this type.

New balanced type reaming shell, designed and perfected by Christensen, utilizes an extra hard matrix metal that increases shell life over that of the insert type shells. There is a slight additional charge for hard facing.

The casing bit has box thread (pin thread available) and extra hard matrix. It is used for collaring holes and for reaming a hole for casing.

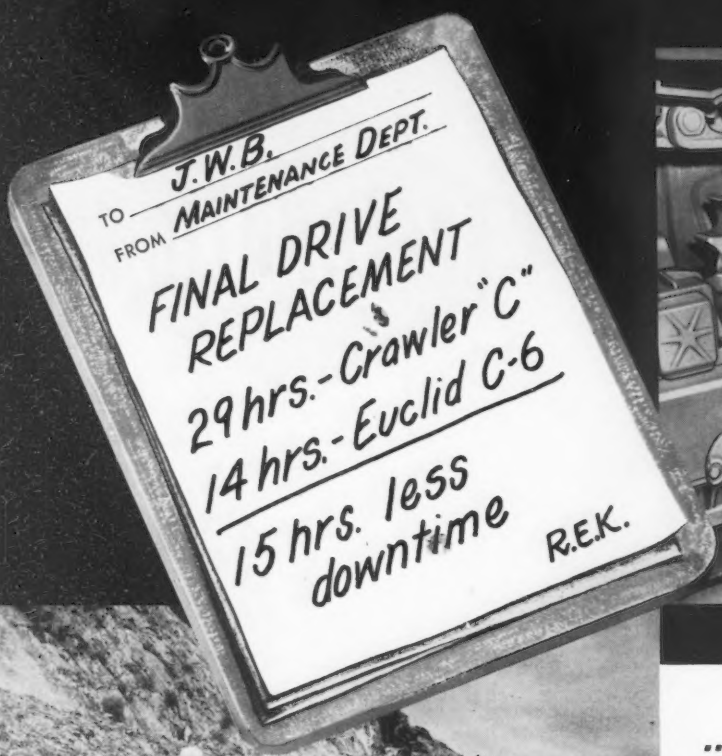
"Less cost per foot"

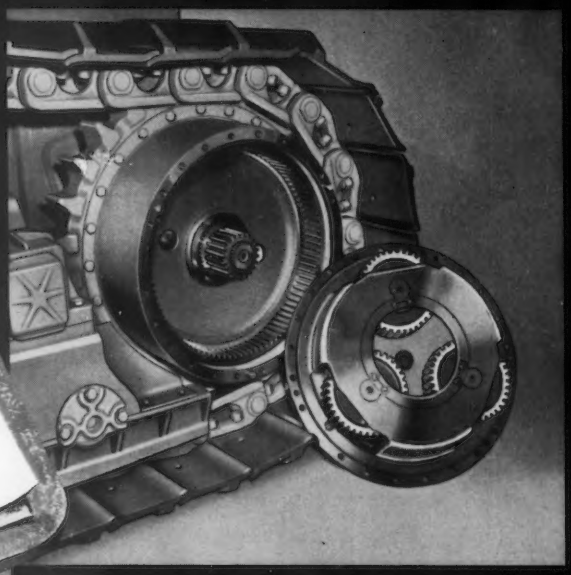
Rock differs in drillability from area to area. Christensen will custom design your bits to insure you of drilling at "Less Cost Per Foot." Contact Christensen today.

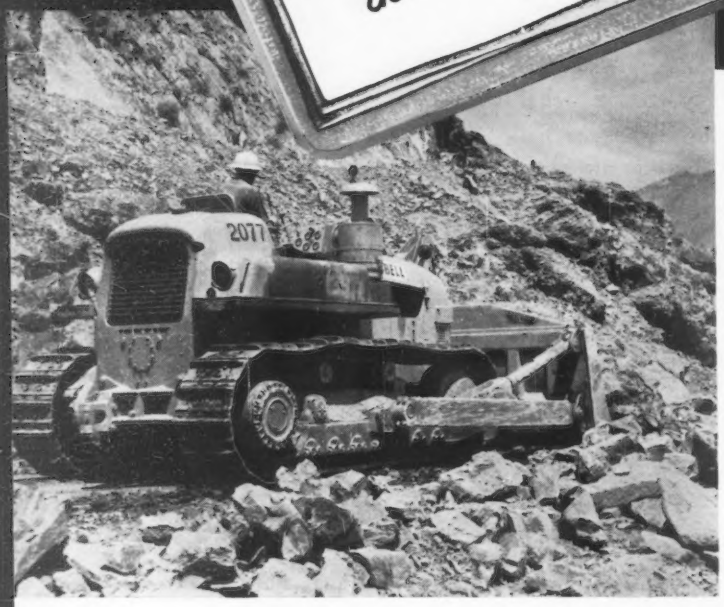
Mining Division of the

CHRISTENSEN DIAMOND PRODUCTS

MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST
P. O. BOX 387 SALT LAKE CITY, UTAH







...a saving of 15 hours labor and productive time with the C-6 and no special tools required!

C-6	Crawler "C"
Planetary Gears . . . . . 3 hours	Gears and Bearings . . . 16 hours
Inside pinion and drive gear reduction . . . 11 hours	Top pinion from steering clutch with bearing and shaft . . . . . 13 hours
Total . . . . 14 hours	Total . . . . 29 hours

Times shown are for removal and replacement of final drive with all components in place.

With a 15 hour saving for final drive replacement the "Euc" C-6 gives you 15 hours more productive time on the job! Easy accessibility that's designed into the C-6 and Euclid's time-tested planetary drive save hours of repair labor . . . that means less downtime and more production. Compare these savings in terms of lower costs . . . add the extra hours available for work on the job . . . then you'll see what just this one advantage can do in cutting operating cost.

The Euclid dealer in your area would like to prove that the C-6 is the lowest cost tractor in the 200 h.p. class . . . and the most versatile by far. He's sure of it, and wants you to know the facts, too!

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DIVISION OF GENERAL MOTORS, HUDSON, OHIO

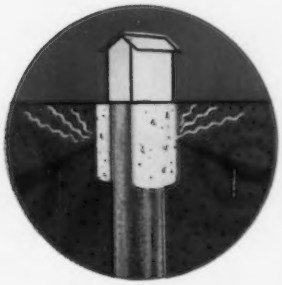
Plants at Cleveland and Hudson, Ohio and Lanarkshire, Scotland

HOW HALLIBURTON GROUTING VERSATILITY SOLVED THESE PROBLEMS

WATER RESERVOIR LEAKAGE

Irvine, Ky. — A reservoir adjacent to the Kentucky River was losing considerable water through permeable stratum beneath the reservoir dam. SOLUTION: Halliburton Pressure Grouting Service was engaged to build a cutoff "wall" through the permeable stratum. Grouting holes were drilled into the permeable stratum. Halliburton DOC (Diesel Oil Cement) grout was selected because of its ability to set almost immediately when contacted by water. Water leakage from the reservoir was completely halted.

SALT MINE WATER INTRUSION



Avery Island, La. — The wall of this 15′ x 20′ ventilation and access shaft, 508′ deep, is formed of open salt except for a concrete caisson lining the top thirty feet. Water had dissolved the salt behind the concrete at the caisson base, allowing water intrusion into the shaft. The water was dissolving and eroding the walls all the way to the mine floor. SOLUTION: Halliburton studied the problem and simulated these subsurface conditions for a long series of experimental injection tests prior to presenting a grouting plan for approval. It was decided to inject Halliburton Bloxall chemical grout at unusually low pressures and volumes to effect a water-tight seal between the salt dome and overburden without adversely affecting the salt, and to consolidate the fine water-bearing sand surrounding the shaft. Two concentric perimeters of grouting holes were drilled around the shaft. Pipe was placed in the holes and perforated at carefully selected depths with Halliburton's perforating tool. Accurate injection pressures were maintained at exacting levels by Halliburton's versatile six-plunger grouting pump. Pressure tests and observation after the job determined that the shaft was dry following this treatment and indicated that the surrounding formation was consolidated.

COMPRESSOR STATION VIBRATION

Wichita, Kan. — Excessive vibration in this compressor station building and surrounding area was apparently being caused by harmonic action of the compressors plus the inability of loose sand underlying the foundation to adequately anchor the structure. SOLUTION: A pattern of grouting holes were drilled through the floor of the building and into the unconsolidated sand formation. Halliburton Chemical grout was selected because it was necessary to actually penetrate the pore spaces of the loose sand. Following the chemical grout placement through perforations, the loose sand was consolidated and tied together, thus eliminating the damaging effects of vibration on equipment and protecting gas lines leading into the building.

CONSULT YOUR HALLIBURTON GROUTING SPECIALIST for more details on helping you solve these and many other difficult problems with the advanced techniques of Halliburton Pressure Grouting Services. He is as near as your phone.

Halliburton is financially able to perform any size grouting operation as a prime or sub-contractor

PRESSURE GROUTING SERVICES

Halliburton
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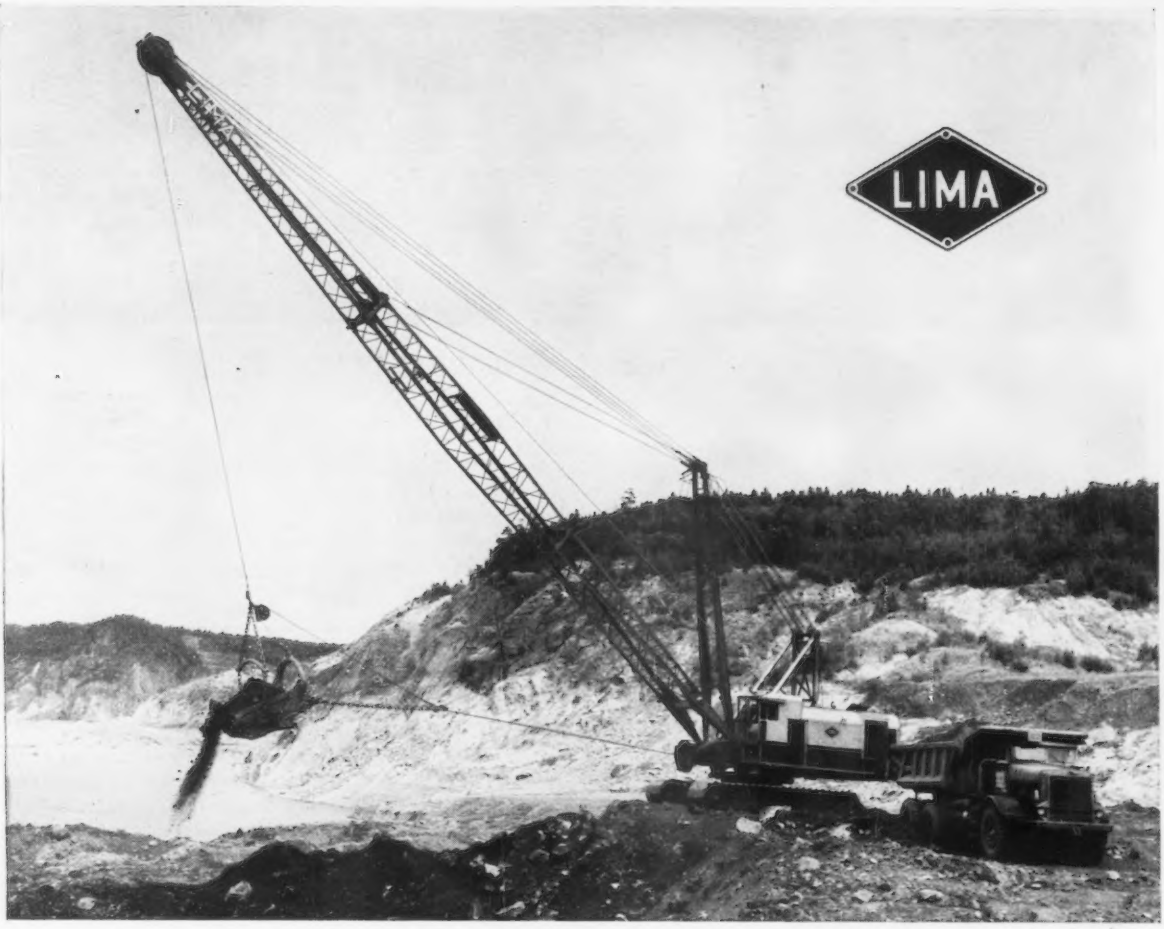

Lima Type 2400 dragline speeds iron ore stripping operations.

Limas dig, strip or load more . . . for less cost!

It takes a rugged breed of men and machines to mine the ores deposited so willfully around the globe by nature. Limas are part of that special breed. For wherever mining jobs call for more digging, stripping and loading capacity . . . at less cost . . . you will find Limas doing more than their share of the work.

Muscled for big jobs

The Lima Type 2400 is muscled for the really big mining jobs—as a variable capacity dragline, 8 cu. yd. shovel, or 110-ton crane. It is mounted on wide and long crawlers for extra ground contact and easy handling. Large-diameter drums are extra wide for increased cable capacity.

Anti-friction bearings reduce wear at all important bearing points. Large air-operated clutches give instant response to controls. Torque converter increases output, reduces shock loading, prevents engine stall, gives cables longer life, and lowers maintenance.

Lima quality pays

These are only a few of the many quality features that pay off for you with a Lima. As hundreds of mining operators have found, Lima's extra engineering features and built-in quality mean greater tonnage and higher profit.

There is a Lima type and size for every mining operation! Shovels ¾ to 8 cu. yds., variable capacity draglines, cranes to 140 tons. Get full information today from your nearest Lima distributor on powered-for-profit Limas—or write to us.

This team of hard working Lima shovels speeds Mesabi Range ore loading. At left, 1½ cu. yd.; at right, 3½ cu. yd.

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THE BELT WITH THE HAZARD-PROOF CARCASS!

WILL NOT ROT OR MILDEW — Constantly running salt water cannot rot or mildew 2-ply BOSTRON belt at J. H. Miles Co., Norfolk, Va. No deterioriation from fastener rust, no fastener holding problems.

OUTSTANDING WEAR — Constant impact and friction from razor-sharp oyster shells has not affected the 1/8" Dulon Cover on this BOSTRON belt. Says Mr. Frank M. Miles, President, "Our BOSTRON belt is good as new after 4 years operation . . . Exceeded every expectation!"

BOSTRON'S hazard-proof carcass, combined with Balanced Belt Construction, makes your investment in a superior Dulon Cover the most sensible, dollar-saving way to buy belts for your requirements.

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ROTA-BLAST BITS!

...engineered for faster blast hole drilling

The box is new! And basic improvements have been made in every size and type of the Hughes "Rota Blast" rock bits. Even the series names have been changed.

New air system and changes in cone bearings in all series assure longer bit life — lower cost per foot of blast hole drilled. In the new tungsten carbide "HH" series, changes in cutter design are increasing bit life as much as 100% in areas where rotary drilling is toughest. In the steel-tooth "H" series, improved hardfacing on the cutting structure and new air system are substantially increasing footage.

Improvements in the "Rota-Blast" line are a direct result of Hughes' continuing research program in the laboratory and in the field to provide bits that will dig blast holes faster and at lower cost.

NEW

Type **S**

Replaces OSC Series
for soft formations
(Calcite, shale, clay)

NEW

Type **M**

Replaces OW Series
for medium rock (Limestone,
sandstone, sandy shales)

NEW

Type **H**

Replaces W7 Series
for hard rock (Siliceous limestone,
dolomite, sandstone, granite)

NEW

Type **HH**

Replaces RG Series
for extremely hard abrasive
rock (Taconite, quartzite)

Your Hughes representative can recommend the "Rota-Blast" bit best suited to your operation. His specialized rotary rock bit experience also qualifies him to offer you assistance in your drilling program.

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A New Look at VARIAN'S MAGNETOMETER FAMILY

The "Proton Free Precession" types find diverse applications; an "Optical Pumping" instrument extends research capabilities.

The simplicity, ruggedness and absolute accuracy made possible by Russell Varian's "Proton Free Precession" concept has made **proton** magnetometers the world standard in less than a decade. Using this principle, total magnetic intensities are quickly measured, without critical orientation or calibration requirements. Recent application of the "Optical Pumping" concept has enabled Varian Associates to develop a **rubidium vapor** magnetometer, with the highest sensitivity available today. This new instrument measures total magnetic intensities on a continuous basis.

OBSERVATORY

Varian's V-4931 Modular Station Magnetometer **(proton)** is a highly versatile and accurate monitor of the earth's magnetic field. Strip-chart analog records and digital readout are supplemented by printed-tape output which may be engaged, as desired, to provide permanent digital records. The V-4934 Station Magnetometer **(rubidium vapor)** is particularly suitable for measuring and recording geomagnetic micropulsations.

PORTABLE

The Varian M-49, a complete **proton** magnetometer weighing less than 20 lbs., furnishes direct readings in gammas every six seconds. Sensitive to better than ±10 gammas, it requires no calibration or levelling and is so versatile it can make equally accurate field records from surveys on land, in the air, or over water. Eight plug-in tuner ranges, equally spaced from 19,000 to 101,000 gammas, allow operation throughout the world.

AIRBORNE

The V-4914 Airborne Magnetometer **(proton)** is a rugged, lightweight and compact version of Varian's Station Magnetometer. Sensitivity and accuracy are of observatory quality. Coarse- and fine-scale strip-chart records may be supplemented with punched-tape. The virtually indestructible "bird" contains no mechanical or electronic parts. Varian's V-4914 is easily accommodated in single-engined aircraft. Range: 22,500 to 73,400 gammas.

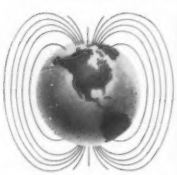
OCEANOGRAPHIC

An accessory "fish" towed up to five hundred feet astern of the hydrographic vessel is the sensing adjunct to Varian's V-4931 for oceanographic survey work. Suitable for broad-scale undersea mapping or offshore geophysical exploration, it furnishes information of observatory quality. Analog and digital readout and records, accuracy and operating range are identical to the observatory model.

RESEARCH

Examples of current projects in Varian's research and engineering laboratories include **proton** and **rubidium vapor** miniaturized magnetometers stressed for missile, satellite, and deep-space applications and instruments being developed for specific military applications, such as ASW. Varian's practical contributions to magnetometry are continuing to advance the state of the art.

For further information on magnetometer sales or leases in many countries of the free world — For loan of the Varian 16 mm color and sound movie on proton magnetometry — For copies of Varian's new Geophysics Technical Memorandum Series — call, wire or write Instrument Division



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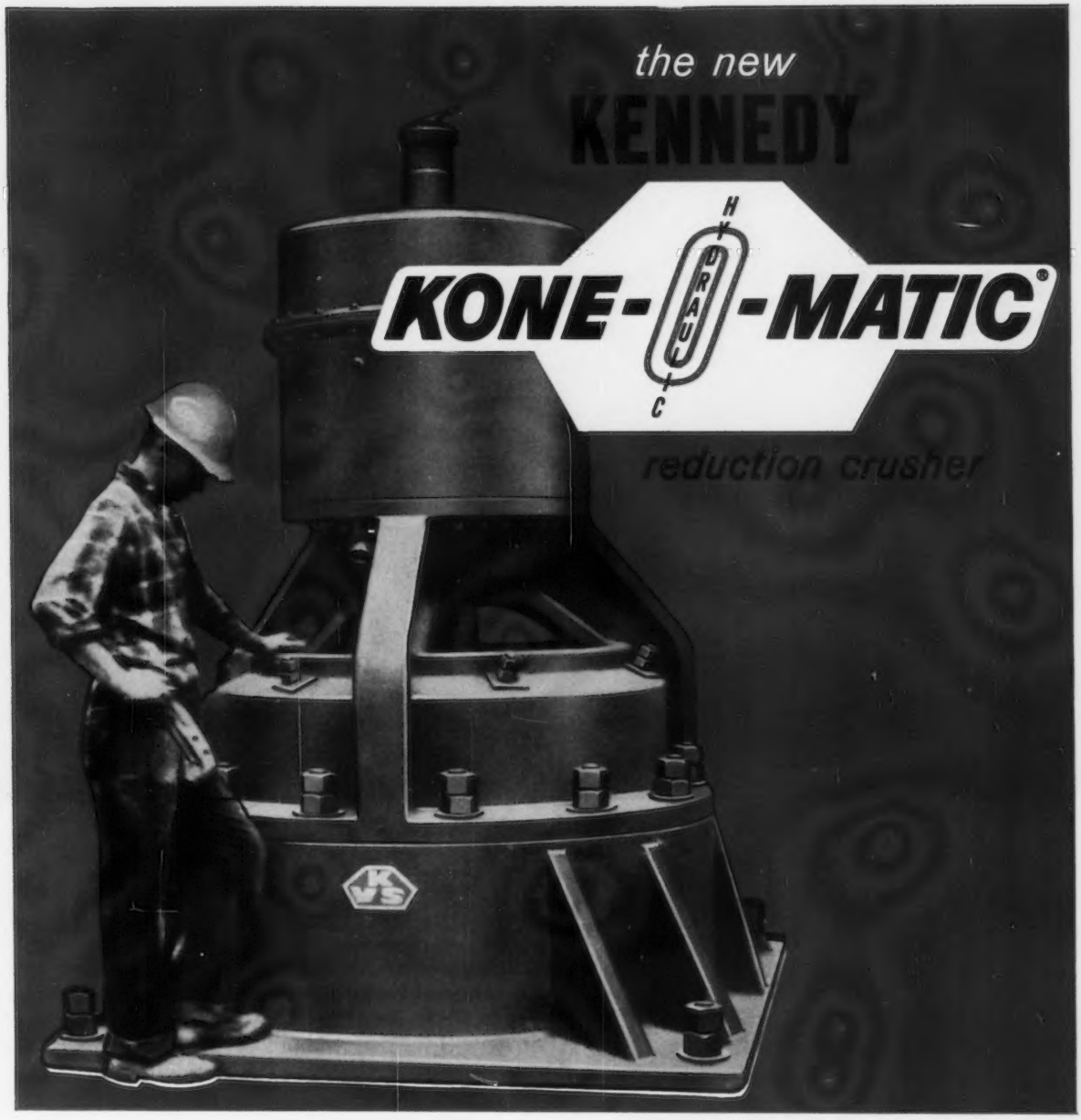

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- **Tramp iron is automatically released and *KONE-O-MATIC* is back to its setting *fast*, with no strain, shock, bump or damage!**
- **Setting can be changed instantaneously by finger-tip control without shutdown!**
- **And the new *KONE-O-MATIC's* feed opening is lower and larger, size for size, than any other crusher we know of!**

These, and many other exclusive features, add up to more productive hours per year, and therefore, more output; to fewer operating headaches; to a more evenly sized product; and best of all, you'll save on overall operating cost! This has been proven in actual quarry operations! We know you'll like the *KONE-O-MATIC!*

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The Mining Machines You'll

YESTERDAY, Marion rail-mounted steamers were the marvel of their era, taking back-breaking labor out of loading and helping giant industries move toward big production.

Here are the machines that will set new pit standards in the decade ahead . . . machines that will help write new chapters of progress in world mining history. And, they will do it through the simple expedient of providing owners with features that 1. cut costs, 2. reduce maintenance, and 3. increase profits. Here are just a few of those features.

1. Dipper capacity up from 8 to 9 cubic yards on the 181-M; from 10 to 11 cubic yards on the 191-M.

2. New crawler design incorporating greater clearance between side frames and crawler lugs; doubled strength in larger, hardened roller pins and shafts; manganese bronze bushings for extended operating life.

You get **MORE** *with* **MARION**

Need in the 1960's

3. Operator's cab on the 181-M extended to the side for greatest possible visibility.

4. Induction hardening of important gears to cut maintenance costs.

5. Heavier top plate, reinforced lower frame for maximum rigidity under toughest working conditions.

6. New concepts in excavator control which will make the present Marion outstanding control system even better.

These plus many other important design features will help owners of these units explore new horizons of high profit excavating in the 1960's.

TODAY, the daily output of Marion 4161 and 151-M machines in the open pit mines sets industry standards for costs. Dependable Marions will continue to mine a big percentage of the world's ore for years to come.

MARION POWER SHOVEL CO. — MARION, OHIO

A Division of Universal Marion Corporation

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MINE-O-MOTIVE

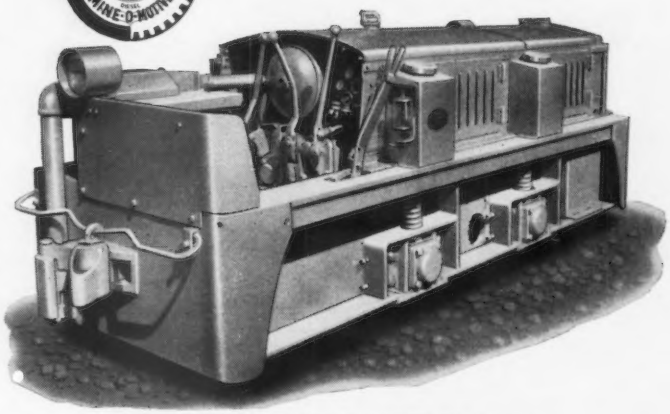
Mine Locomotives 3 to 12 Tons

Engineered expressly for

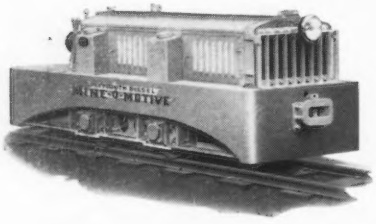
YOUR LOCOMOTIVE HAULAGE

in Today's modern mining operations

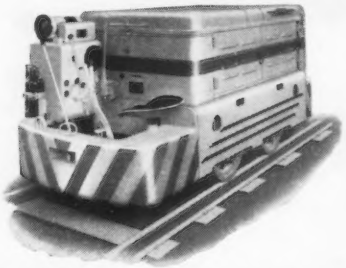
You will find these rugged locomotives performing the toughest hauling jobs in mines and tunnels everywhere. Stamina, stability—ECONOMY in performance, SAFETY in operation—and extra years of trouble-free operation—are ENGINEERED in the design and construction of the Mine-O-Motive series. Controls are convenient, simple, safe. Visibility is excellent. And the Diesel-powered models shown have the famous Torqomotive* Drive for easy starting and smooth operation. They supplement Plymouth gasoline, Diesel and Diesel-electric models which have served all industry since 1914—and with lowest ton-mile costs in the field.



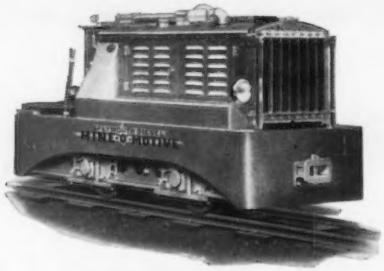
U. S. Bureau of Mines approved exhaust conditioning equipment.



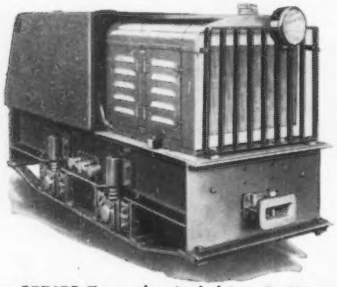
MINE-O-MOTIVE SERIES
Model FMD-00 5 or 6 Tons, Torqomotive* Drive—short wheel base, low center of gravity.



MINE-O-MOTIVE SERIES Model FMD-22 5, 6, 7, 8 or 10 Tons, Torqomotive* Drive (this model approved under Permissible Schedule #22, U. S. Bureau of Mines, for operation in gaseous mines).



MINE-O-MOTIVE SERIES
Model DMD-00, 8 to 12 Tons, with Torqomotive* Drive — low, compact, one-piece welded frame.



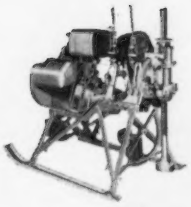
SERIES T, mechanical drive, 3, 3½ or 4 Tons. Torqomotive* Drive in 3½ or 4 Tons.

FREE ANALYSIS Send us a brief outline of your hauling operations. An engineering analysis will reach you promptly with latest data on the type and size Mine-O-Motive for the best results in the work you want done.

PLYMOUTH LOCOMOTIVE WORKS

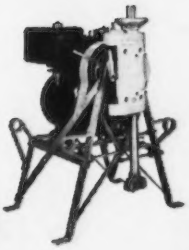
Division of the Fate-Root-Heath Company
Dept. A-22, Plymouth, Ohio

**TORQOMOTIVE DRIVE: Plymouth Transmission coupled to Hydraulic Torque-Converter.*



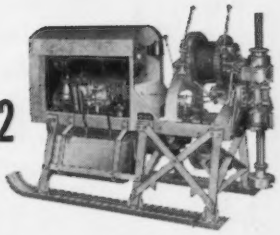
BBS-1

World's best known surface drill. Handles "E" Rods to 1,500 ft., "A" to 1,100 ft.



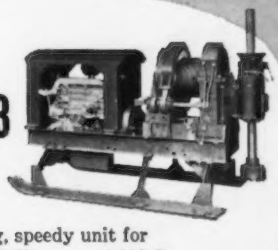
x-ray

Compact, portable—185 lbs. net. Takes ¾" or ⅞" core to 200 ft. Low fuel consumption.



BBS-2

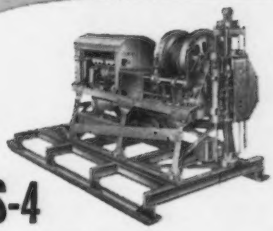
Versatile, choice of 5 swivelheads. Depths to 3,500 ft. Gas or diesel.



BBS-3

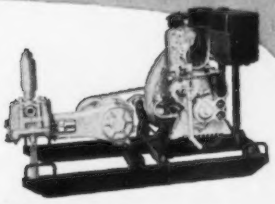
Strong, speedy unit for deep drilling . . . 4,600 ft. with "A" or "B" Rods, 95 h.p. diesel.

if it's for diamond drilling we make it!



BBS-4

Drills to 5,000 ft. with "B" Rods. Moves under own power, gas or diesel.



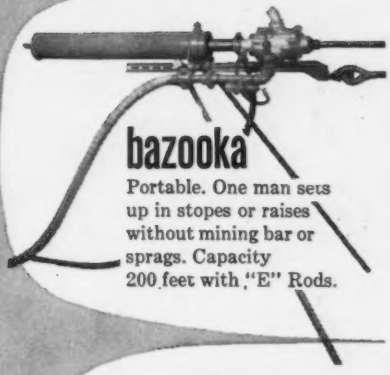
drill pumps

5-12 and 4-7 models. Capacities 400 to 1,200 g.p.h. Diesel motor optional.

permaset bits

(Powdered metal)

All standard sizes available from stock. Also reaming shells, etc.



bazooka

Portable. One man sets up in stopes or raises without mining bar or sprags. Capacity 200 feet with "E" Rods.

JV

4 feed swivelhead. Capacity 800 ft. with "E" Rods. JVR with right-hand feed screw for blastholes.

BBU-2

Rugged. Capacity 1,800 ft. with "E" Rods, 1,400 ft. with "A", four gear speeds.

VEG

Vane motored version of J.V. Lightweight, compact construction. Can be speedily dismantled into two units.

58-5

BOYLES BROS DRILLING COMPANY LTD. VANCOUVER, CANADA

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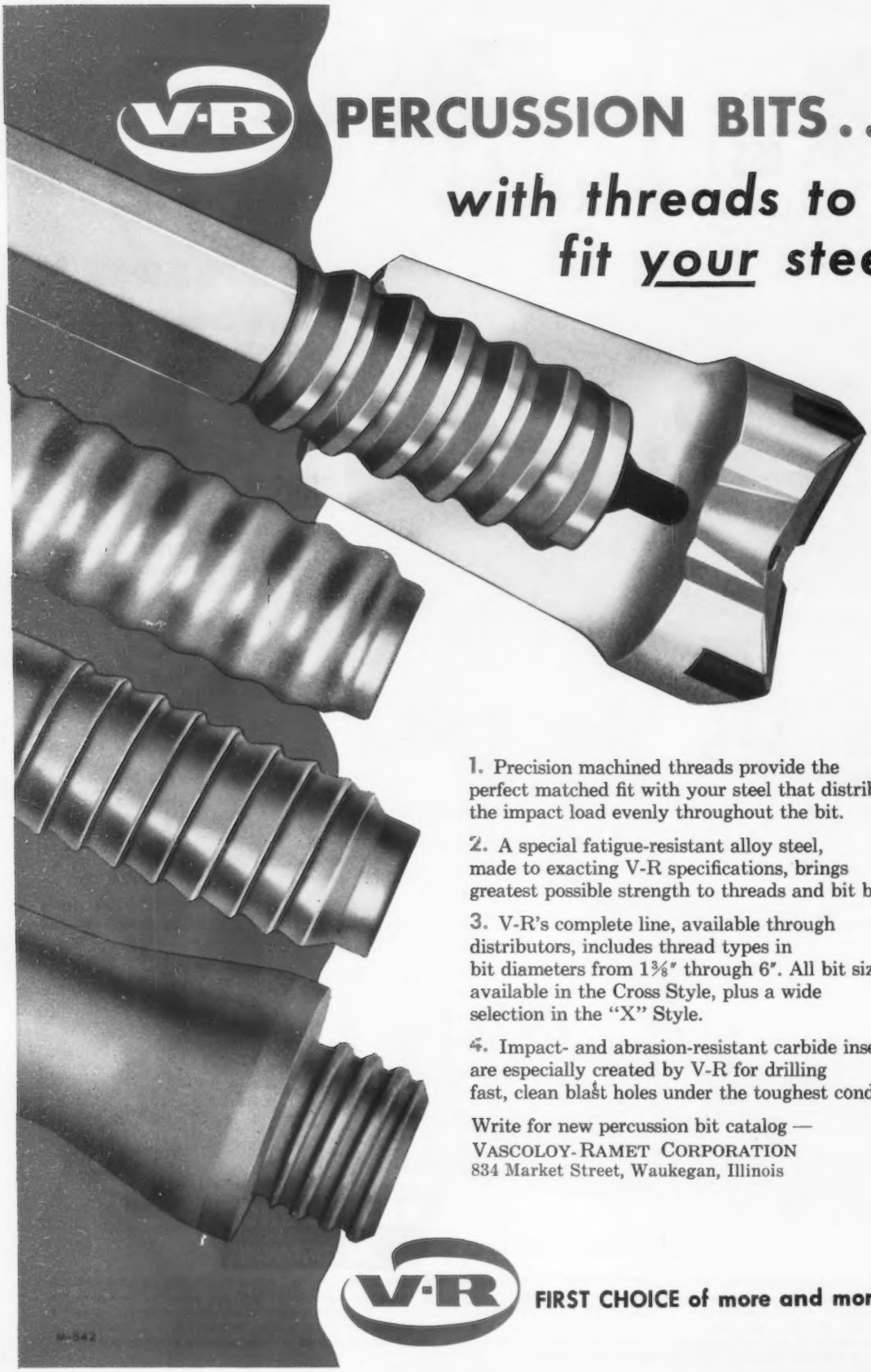


V-R

PERCUSSION BITS...

with threads to fit your steel!

1. Precision machined threads provide the perfect matched fit with your steel that distributes the impact load evenly throughout the bit.

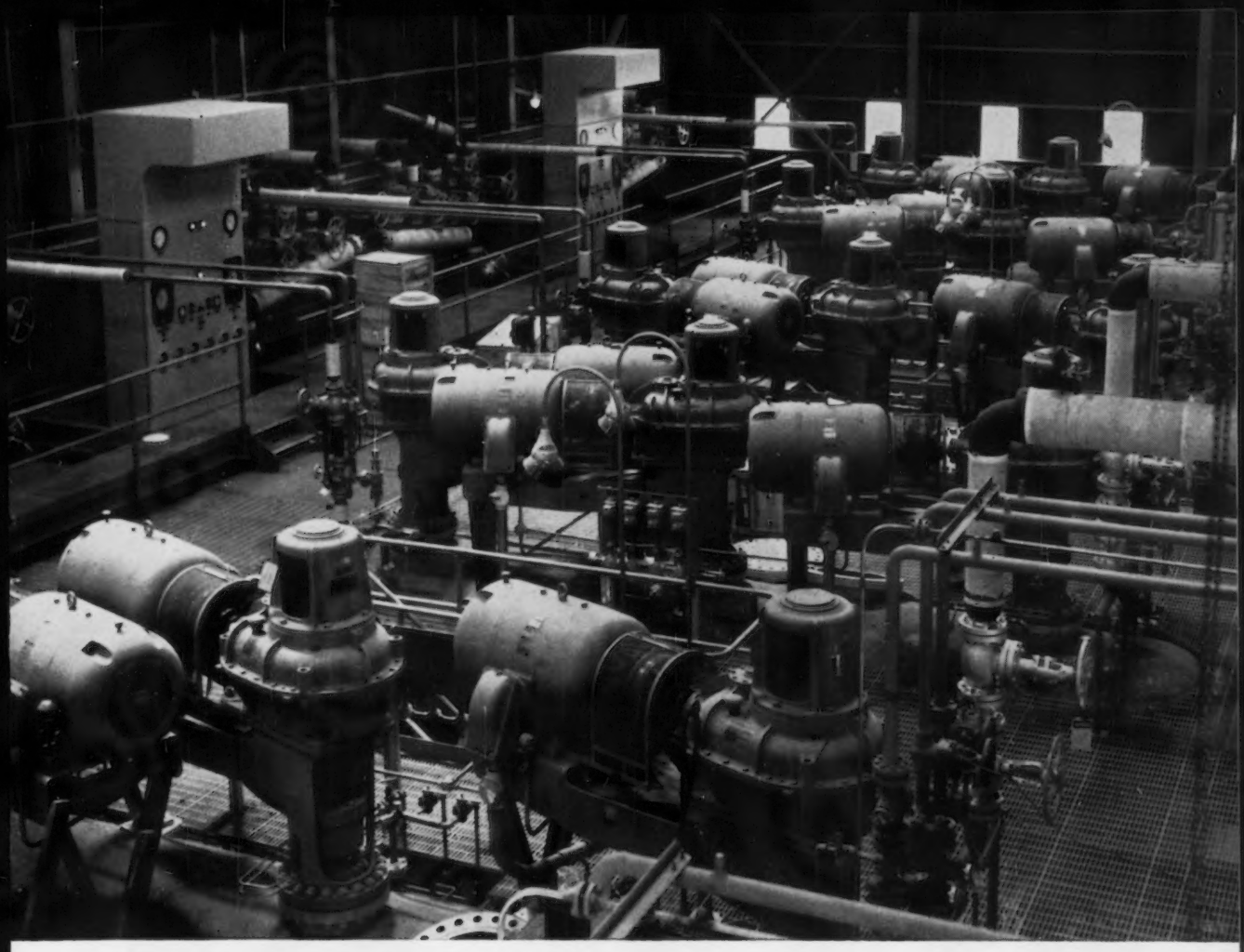
2. A special fatigue-resistant alloy steel, made to exacting V-R specifications, brings greatest possible strength to threads and bit body.

3. V-R's complete line, available through distributors, includes thread types in bit diameters from 1⅜" through 6". All bit sizes are available in the Cross Style, plus a wide selection in the "X" Style.

4. Impact- and abrasion-resistant carbide inserts are especially created by V-R for drilling fast, clean blast holes under the toughest conditions.

Write for new percussion bit catalog —
VASCOLOY-RAMET CORPORATION
834 Market Street, Waukegan, Illinois

V-R **FIRST CHOICE of more and more drillers**



SETUP for a powerful lot of mixing

Beneath this forest of LIGHTNIN Mixers churns a small ocean of nickel being born.

You're seeing the country's first major refinery of the strategic metal—new 50-million-pound-a-year facility of Freeport Nickel Company in Louisiana. Mixing is a crucial step in the monster autoclaves that reduce nickel-sulphate solution to pure powdered nickel at high temperature and at pressure well over 600 psi.

As hydrogen hisses into the six autoclaves, 18 big dual-turbine impellers grip the heavy slurry and expose every ounce of it to the gas. As pure nickel forms, the mixers keep it suspended uniformly to seed the reaction. New charges of pregnant liquor flow in, and the densification process begins anew.

Each time a mixer starts, it may start with its lower impeller buried in settled nickel solids that throw a load of 300% of normal full torque upon the 125-hp mixer drive. A fluid coupling between motor and drive, and the distinctive hollow-quill design which is standard on Series E LIGHTNIN Mixers, insure that the shock never reaches the mixer drive gears.

Each mixer shaft enters the autoclave through a LIGHTNIN double mechanical seal that holds pressure leakage to zero. If it ever wears out, the seal can be replaced without dismantling the mixer, without removing it from the autoclave, and without disturbing gear alignment.

Engineers at Freeport Nickel *knew* what their mixing results would be long before they approved these mixers. MIXCO engineers lived with the project for months, checked power requirements by scientific methods, and demonstrated mixing results accurately in scale-model equipment.

If you'd like to take the guesswork and the risk out of fluid mixing on *your* next project, large or small, call in your LIGHTNIN Mixer representative. He's listed in Chemical Engineering Catalog and in the yellow pages of your phone directory. Or write us direct.

Lightnin® Mixers

MIXCO fluid mixing specialists

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Crushes almost any ore . . .

. . . faster,
cheaper,
better!

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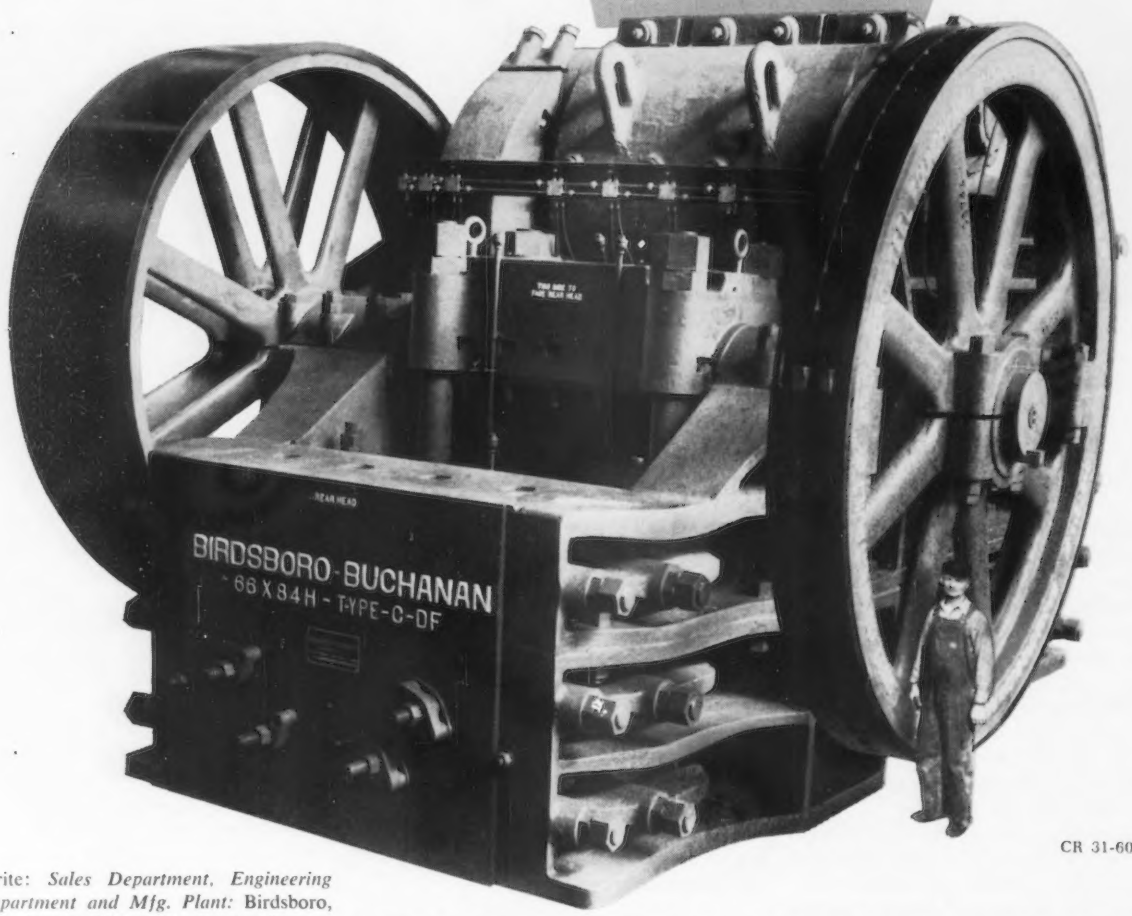
Cu · W
Pb · U

BIRDSBORO BUCHANAN
deep-frame Jaw Crushers



CR 31-60

Write: *Sales Department, Engineering Department and Mfg. Plant:* Birdsboro, Pa., *District Office:* Pittsburgh, Pa.

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The BELT Lasts Longer!

(and so do maintenance dollars!)

. . .with McNally Pittsburg's new conveyor

Here is a new and entirely different type of belt conveyor. The secret of its amazingly improved efficiency is in the exclusive design of the McNally Pittsburg patented cradle idler, which consists of 5" rubber rollers, assembled on precision-ground ball bearings, prelubricated and lifetime sealed. The rollers are suspended in a true catenary, on flexible, nonrotating stainless steel wire rope, which cannot corrode. Because the wire rope does not rotate, it cannot twist and cause loping, dangerous harmonics, and undue belt wear.

The wire rope is supported at each end by a simple ball joint, so it is free to move in any direction, permitting the belt to adjust itself to any profile. The true catenary suspension provides uniform belt support without bends or creases. *Thus belt life is substantially increased.* The entire conveyor is shipped disassembled, and may be put together in the field to fit your application.

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☐ Please send information on the new McNally Pittsburg Belt Conveyor.

☐ Have Sales Engineer call for further consultation.

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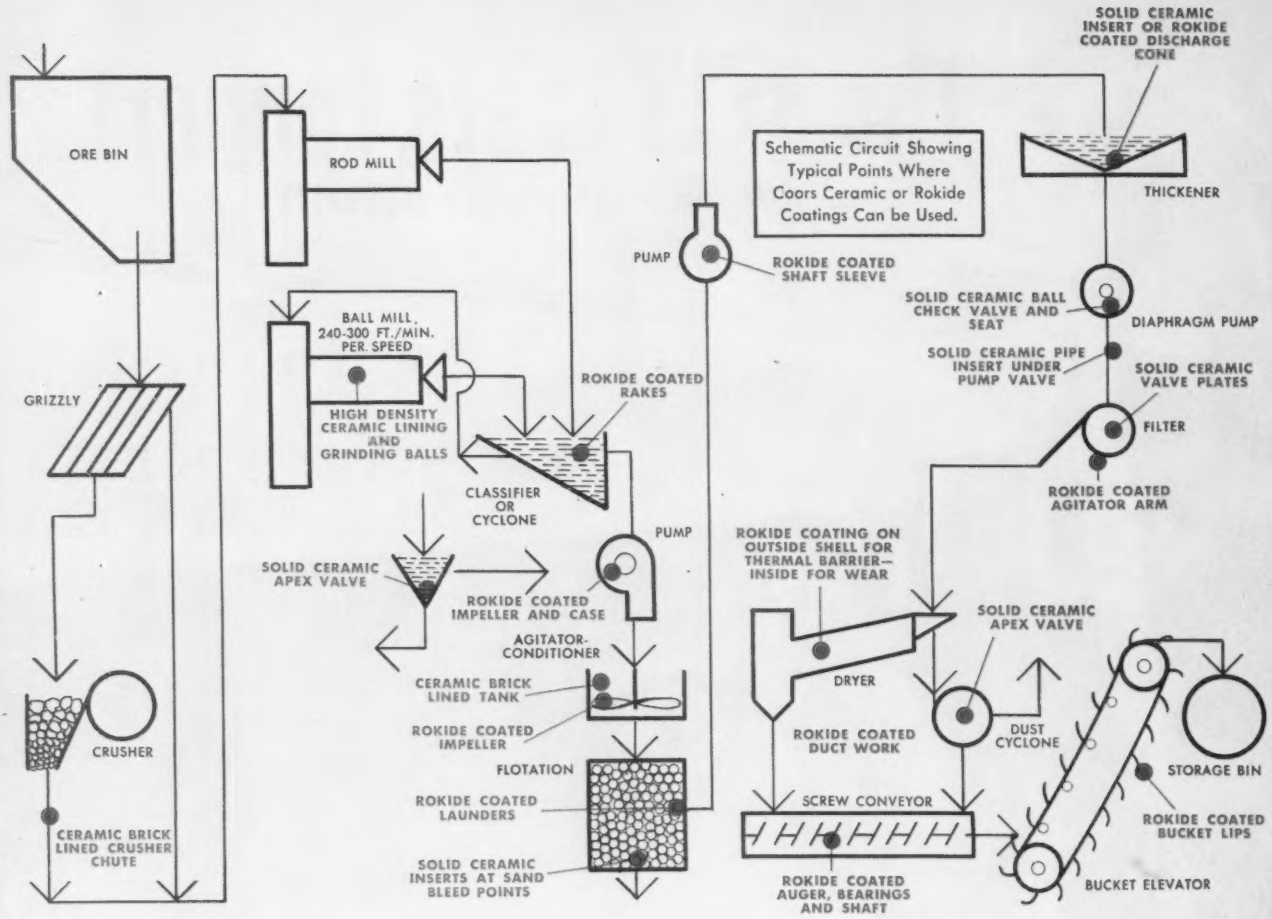
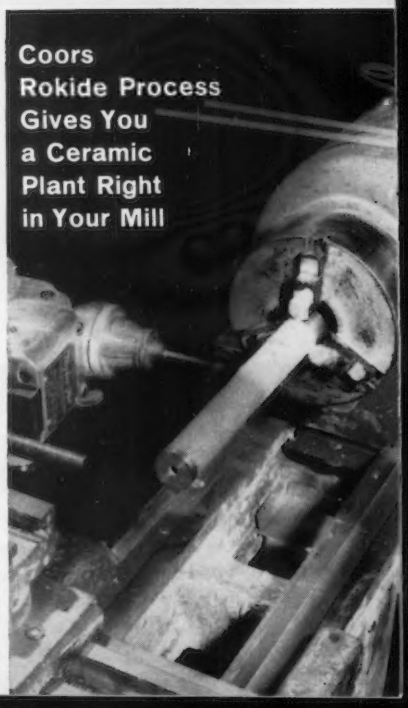


ALSO: MECHANICAL PUMP SEALS; MULLER WHEELS AND PLATE; METERING ORIFICES

Solve Wear and Corrosion Problems

Critical wear and corrosion points in your circuit can be protected with Coors high strength ceramic parts or coatings. Solid ceramic parts are sapphire hard (Rockwell 45N 75-81), and strong (over 30,000 psi Tensile Strength, over 350,000 psi Compressive Strength)—providing high resistance to wear and abrasion. The ceramic is virtually inert to chemical attack. Rokide ceramic spray coatings have many of the advantages of the solid ceramic parts. Take a look around your mill and see if Coors Ceramics can help you solve critical wear and corrosion problems. Write for Data Sheet 0001 giving properties of solid ceramic parts—Data Sheet 9000 for Rokide coatings. *Coors supplies solid ceramic lining bricks and grinding balls. Most solid ceramic parts can be ordered through your equipment manufacturer. Coors offers process licenses and material so you can do Rokide coating right in your mill.*



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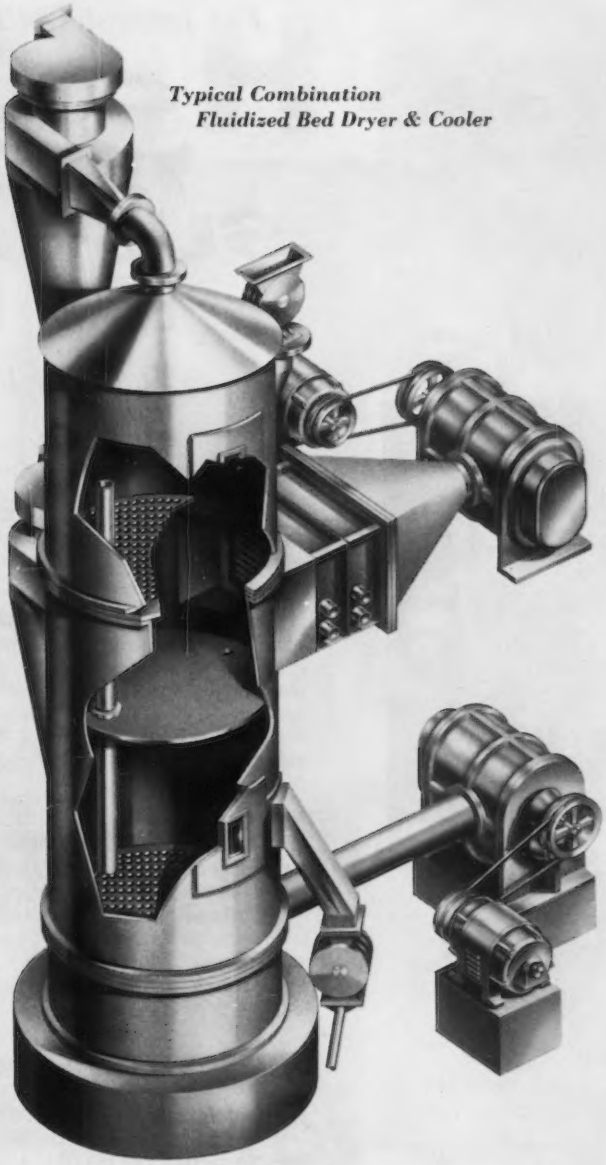
YOU'LL FIND NO "HOT SPOTS" IN LOUISVILLE FLUIDIZED BED EQUIPMENT



Typical Combination
Fluidized Bed Dryer & Cooler

Louisville Fluidized Bed units are meeting with unusual success as dryers, coolers and reactors for free-flowing granular materials up to ¼" particle size. Temperatures within the units are remarkably uniform. There are *no* hot spots. The high rate of heat transfer and the constant turbulence inherent in their operation create conditions that for all practical purposes are isothermal.

The operating range of Louisville Fluidized Bed Equipment is from 50° F. in the case of coolers to as high as 1500° F. in calciners and reactors . . . up to 2500° F. in special cases. By measuring and controlling exhaust temperatures, bed temperatures are maintained within narrow limits.

Response to desired changes is practically instantaneous. Because of this sensitivity to change, the critical temperature of the material being treated can be more nearly approached than in any other kind of dryer or reactor . . . as close as 2° F. in many operations.

For more information about Louisville Fluidized Bed Equipment, please write for Bulletin FBD-61

Process Equipment Division—Louisville Dryers

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For Lowest Drilling Costs, Specify...

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BLAST HOLE BITS

for your drilling requirements

S SERIES — For Soft Formations* Designed to effectively drill the complete range of softer formations . . . shales, soft sandstone, soft limestone. Maximum offset of cones for greatest twisting — tearing action and long teeth assure fastest penetration rates. Self-cleaning action of cutter designs and placement of air courses prevent balling up and permit rapid removal of loose particles from bottom of hole.

M SERIES — For Medium Formations* General purpose bits for fast drilling of medium hard limestone, shaley limestone and other medium formations. Moderate offset is employed to increase penetration rates. Additional gage protection is provided by "T" tooth designs where formations are abrasive. Special cutter features, combined with sturdy tooth design, of these versatile bits, offer greater strength to withstand heavier drilling weights in harder formations.

H SERIES — For Hard Formations* Especially designed for use in harder formations, such as dolomite, hard limestone, traprock. Sturdy teeth, closely spaced on extremely strong cones, are capable of withstanding heaviest drilling weights. Gage tooth configurations are available with "L", "T" and full webb sections for hardest and most abrasive formations that can be cut with steel toothed bits. True rolling, non-offset cutters and extra large bearings assure longest life.

H SERIES INSERT TYPE — For Extremely Hard Formations* Tungsten carbide insert bits are available in three types for hardest, most abrasive formations such as granite, etc. An exclusive Security feature of this series is the special placement of compacts for full gage protection and maximum gage cutting. H8 series features large compacts spaced on raised cutter structures for maximum ventilation and best penetration rates. H10 type, designed for hardest formations possible to be drilled, employs closely spaced large compacts in a "hunting tooth" pattern to avoid tracking and to maintain full coverage of bottom hole. H10 features rugged spear points with spirally placed compacts. H9 series is mid-way in hardness range between H8 and H10. Security insert bits have conical shaped points on compacts insuring faster penetration rates.

Security SUPER-AIRE bits feature extra-large, self-cleaning screens, maximum capacity bearings, and air passages to bearings unrestricted by ball retainer plugs as in other bits.

**Jet air or regular air types available. Send for catalog.*

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DRESSER INDUSTRIES, INC.

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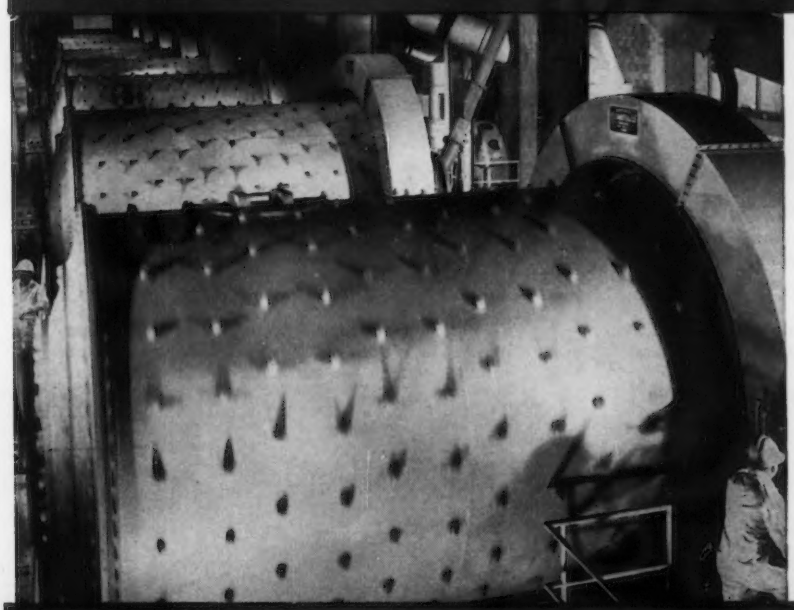
For sintering, nodulizing, calcining, desulphurizing, oxidizing and reducing roasting. Coolers, precoolers, preheaters, recuperators.
Auxiliary equipment for Rotary Kiln Plants.



grinding mills

Ball mills, tube mills and multicompartment mills—open or closed circuit—wet or dry grinding.
Also airswept for grinding and drying.
Over 1350 Smidth Rotary Kilns and over 5000 Grinding Mills supplied all over the world.

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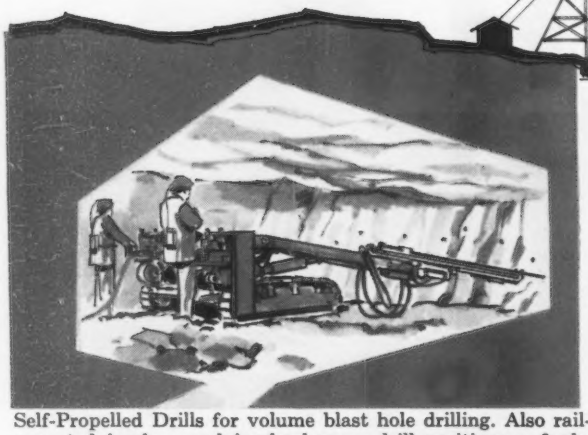
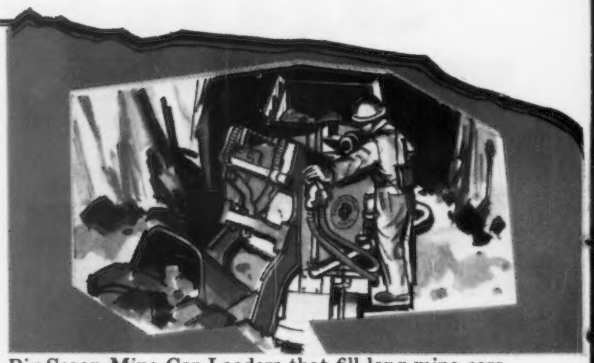
GARDNER-DENVER GOES

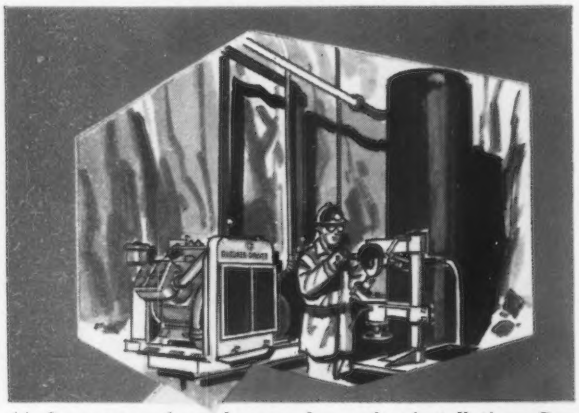


Self-Propelled Drills for volume blast hole drilling. Also rail-mounted jumbos, and jumbo booms, drill positioners, feeds, drills, and remote controls for building your own drilling machine. Big bore drills for burn cut holes.



Big-Scoop Mine Car Loaders that fill long mine cars fast. Extra power for crowding, extra speed at discharge. Low center of gravity. Controls can be moved from side to side.

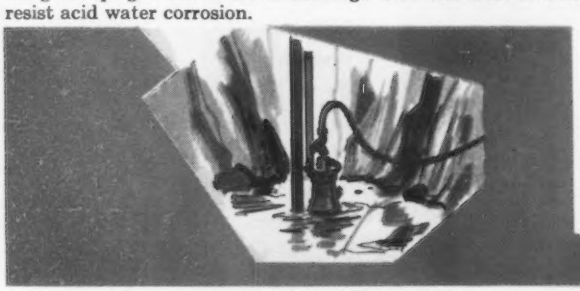
Bit Grinders, bench- or pedestal-mounted, sharpen carbide bits in the workings.



Air Compressors for underground or surface installations. Compact W-type models have two-stage compression, self-contained cooling system that conserves water.

Powerful Stopers for fast, easy up-hole drilling in stopes or raises. Well-balanced. Easy to run. Telescopic or single extension stingers.

Pneumatic Sump Pumps move water at low cost. Top suction design keeps grit out of motor bearings. Stainless steel models resist acid water corrosion.



Dewatering Pumps—steam-, air- or power-operated. Water supply pumps. High-pressure plunger pumps for surfacing ore in suspension.

PLUS SERVICES ARE BASIC AT GARDNER-DENVER

Sizes and models to suit job requirements • Specialists help you choose correct equipment • Demonstrations of equipment in the field • Ready supplies of replacement parts anywhere • Trained technicians to give you mechanical help • Engineered durability and maintenance economy • Pace-setting new products to meet job demands.

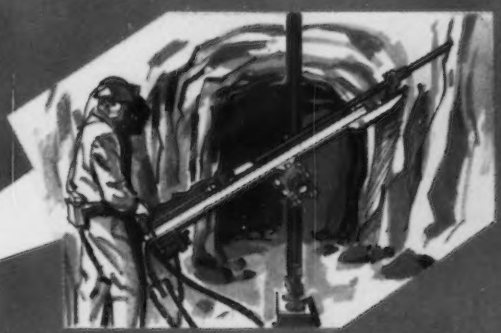
ALL THE WAY TO HELP BOOST ORE PRODUCTION

Throughout the underground mine, Gardner-Denver equipment helps produce more ore at a lower cost per ton. Helps speed exploration and development work, too. Write for product bulletins, or see your Gardner-Denver Mining Specialist for expert advice on choosing the right Gardner-Denver models for your operations.

Air Feed Leg Drills and Legs for the one-man drilling crew. Lightweight and powerful. Simplified controls. Gardner-Denver line oilers for proper lubrication.

Double-Drum "Airslushers" speed ore transfer in the slusher drift. Five-cylinder radial air motor provides powerful tugging action, fast return.

Long Hole Drilling with deep hole drifters, sectional rod and couplings, carbide insert bits. Gardner-Denver "HI-LEED"® steel makes up tight, uncouples by hand.



Complete Roof Pinning Machine. Drills the hole, inserts the bolt and tightens the nut. Powerful, trouble-free, with remote controls.

Hard-Hitting Sinkers for winze, blockholing, and shaft work. Full range of sizes for clearing grizzlies, or heavy-duty shaft sinking.

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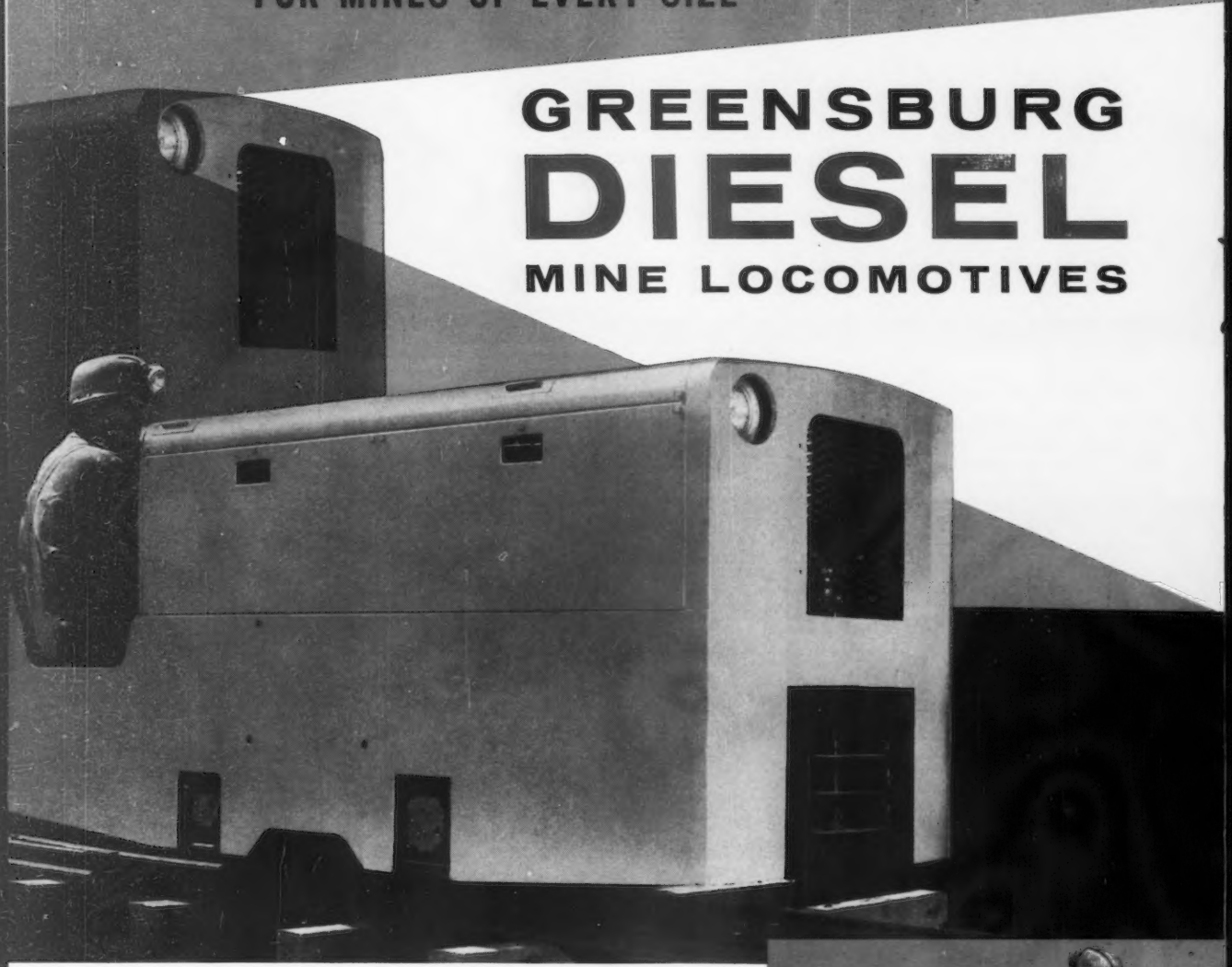
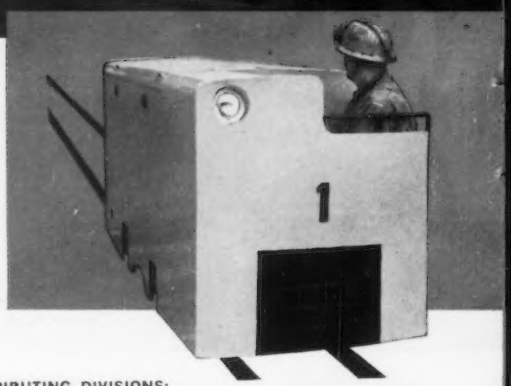
A **NEW FACTOR** IN HAULAGE ECONOMICS
FOR MINES OF EVERY SIZE

GREENSBURG DIESEL
MINE LOCOMOTIVES





2½ to 25 TONS

Lowest maintenance—easiest operation

Get the facts on this remarkable new line of Greensburg Diesels—rugged, powerful, so easy to run that no skilled operator is required. Only three controls—no gear shifting or clutching—highest quality components—exhaust gas conditioner a feature. Send for literature!

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WORKING COMBINATION FOR PIPE LINES IN MINING SERVICE

Mining engineers looking for ways to save time, work and money will like the way that NAYLOR Spiralweld pipe and Wedgelock couplings team up to simplify and speed the job.

Because of its light weight, NAYLOR pipe is easy to handle, easier to install. The lockseamed-spiralwelded structure adds the strength and safety you'd expect from heavy-wall pipe. The NAYLOR Wedgelock coupling saves time in installation because reliable connections can be made with only one side of the pipe in the open.

NAYLOR Wedgelock couplings make a positive connection securely anchored in standard weight grooved ends. A hammer is the only tool required to connect or disconnect the coupling.

To simplify and speed your next job requiring air, water, tailings or ventilating lines, look into this pipe and coupling combination. Just ask for Bulletin No. 59.

NAYLOR PIPE *Company*

1243 East 92nd Street, Chicago 19, Illinois

Eastern U. S. and Foreign Sales Office: 60 East 42nd Street, New York 17, N. Y.

PHONE: SCRANTON, PENNSYLVANIA

DIAMOND 4-8506

FOR ALL YOUR

DIAMOND DRILLING NEEDS...

EQUIPMENT ... AND ... CONTRACT DRILLING SERVICES

MACHINES

A complete line of core drilling machines ranging from the portable Super-Pioneer to the truck mounted 142-C. Rugged construction ... accurate machining ... constant technological progress assure you a modern drill with a long trouble free life, even under the most difficult operating conditions.

EQUIPMENT

Top quality raw materials ... constant quality control in manufacturing ... careful handling assure you of the best in rods, core barrels, casing and other core drill accessories. On standard items there is ample stock ready for fast delivery to you.

"ORIENTED" DIAMOND BITS

Four matrices ... three grades of diamonds ... seven ranges of stone size. Out of the many combinations possible, there is the right bit for your particular job. Give us all of the particulars and we will assist you in choosing the bit we believe best suited for your work.

CONTRACT DRILLING SERVICES

The most modern core drilling equipment ... highly trained drill crews ... expert supervision ... and the drilling "know-how" accumulated throughout our more than 77 years of experience are your assurance of a core drilling job well done.

When you think of diamond drilling ... equipment or contract services ... remember to phone Scranton—DIAMOND 4-8506.

SPRAGUE & HENWOOD, Inc.

S&H

SCRANTON 2, PA.

Member: Diamond Core Drill Manufacturers Association

Branch offices: New York • Philadelphia • Pittsburgh • Nashville • Grand Junction, Colorado • Tucson • Buchans, Nfld.

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IN THE COPPER INDUSTRY

the lining is basic . . .

and General Refractories Company is the world's foremost supplier of basic brick

● Grefco RITEX "CB" (Burned Chrome-Magnesite) brick are used to line copper-anode casting furnaces and holding furnaces. Other Grefco basic brick are sometimes used for this service to meet special conditions. Grefco RITEX "CB" will provide long, trouble-free life.

KROMEBOND, Grefco's basic mortar, has been preferred for many years as a superior bonding material for laying basic brick. Grefco KROMSET is suggested where a strong air-set is desired.

Call Grefco's experienced sales and service representatives for any requirements of refractories, or, if you prefer, contact the main office of General Refractories Company, 1520 Locust Street, Philadelphia 2, Pa., Telephone PEnnypacker 5-2000.

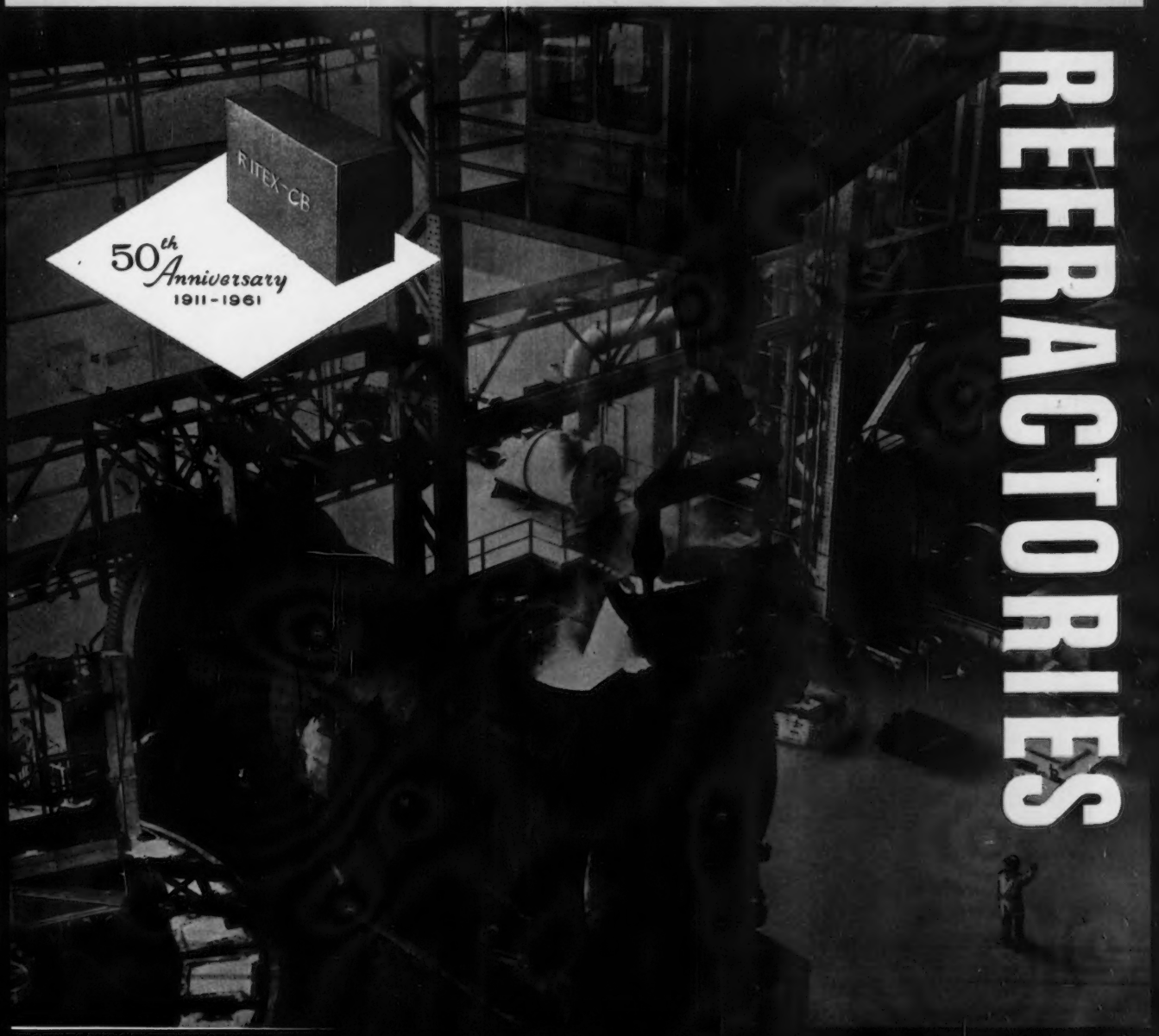
Plants manufacturing Grefco basic brick are located at Baltimore, Maryland; Morrisville, Pennsylvania; Gary, Indiana and Lehi, Utah. Grefco's brands of basic brick are available in Canada from General Refractories, Ltd., Smithville, Ontario.

GENERAL REFRACTORIES COMPANY

General Offices: 1520 Locust Street, Philadelphia 2, Pa.

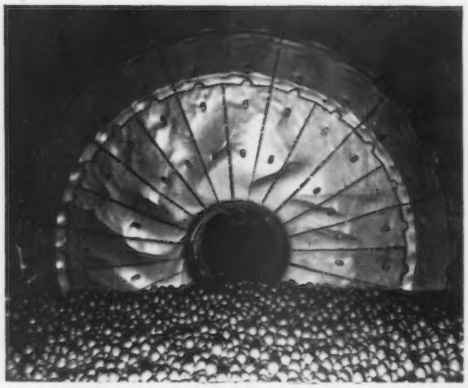
DISTRICT SALES OFFICES IN ALL PRINCIPAL CITIES

GENERAL REFRACTORIES



Amsco dippers last longer loading ore cars. Owners of this mine have converted over 90% of their shovels to Amsco dippers like this 6 cu. yd. model because of their toughness and resistance to abrasion. Excellent Amsco service had a part in the decision, too. This shovel loads about 6,300 tons of ore per 8-hour shift.

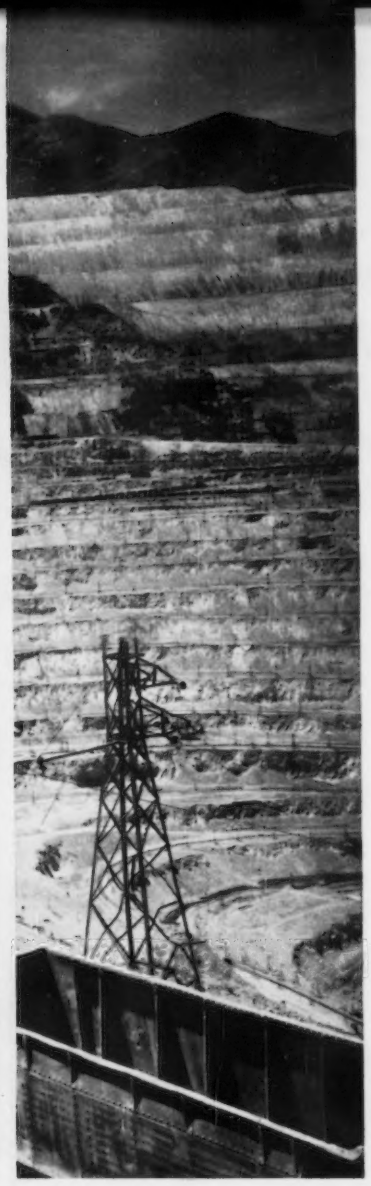
1000 hours of sand harvesting before major servicing. That's the record of this Amsco 6". It pumps 1,200 gallons of 15% sand solution per minute.



Material flows smoothly in ball mills lined with Amsco Manganese Steel. Abrasive material won't cut into the surface which work hardens under impact. User reports 100% better service life from Amsco liners.

Crusher roll life is increased 5 to 10 times with "Pair for Wear" electrodes—Nicro Mang* for manganese steel welding and X-53 for general hardfacing.

*TRADEMARK REGISTERED



AMSCO WEAR PARTS

help you handle more tons per dollar

Impact and abrasion take their toll of wearing parts and cut deep into your profits. Worn dipper teeth, pumps, crusher rolls, dozer end bits and mill liners can cut *tons* off your production.

Amsco alloy castings include manganese steels, chrome-moly steels, multiple alloy engineering steels and high chromium iron—all developed to meet your specific needs whether it be impact, abrasion, or both. Each type is carefully guarded for proper chemical and physical properties and uniform heat treatment.

If wearing parts on machinery increase costs per ton you'd better investigate Amsco alloy wear parts. Your nearby Amsco representative can analyze your particular application and recommend an Amsco alloy product that will produce or move material at the lowest operating cost per ton. If you don't know his name, write and we'll send you his address.

Try this simple test made on this Massachusetts rock job: Two Amsco Simplex 2-part teeth were installed on the outside corners of a shovel dipper. Competitive 2-part teeth were installed between them. Midway through the test the positions of the teeth were changed. Simplex 2-part teeth showed *less than half the wear of competitive teeth.* Tips stay sharp and can be reversed in minutes.

AMERICAN Brake Shoe COMPANY

They're backed by experience...

Other plants in:
Denver • Los Angeles • New Castle, Delaware
Oakland, California • St. Louis
IN CANADA: Joliette Steel and Manitoba Steel Foundry Divisions
IN MEXICO: Amsco Mexicana, S.A.

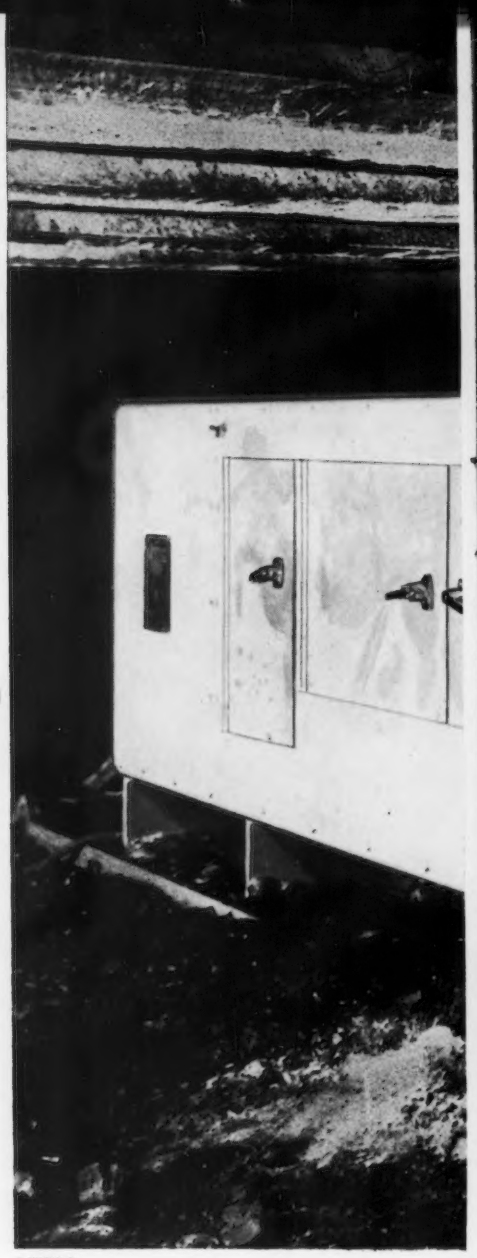
Welding products distributed in Canada by Canadian Liquid Air Co., Ltd.

AMSCO

AMERICAN MANGANESE STEEL DIVISION
CHICAGO HEIGHTS, ILLINOIS

961

ONLY WESTINGHOUSE CONSTRUCTION SUITABLE FOR WORLD'S LARGEST SEALED DRY-TYPE MINE POWER CENTER



J-70899-B

MINE power center specifications are extremely exacting . . . so exacting that only Westinghouse, the leader in the field, offered a construction found suitable for the world's largest sealed, portable mine power center.

Only Westinghouse construction could combine—in a unit with the desired 600-kva, 7200/480-volt rating—the necessary ruggedness, compact low height and light weight essential to easy portability within mine tunnels.

Here are the key features in this construction:

External ruggedness—A ¼-in. steel plate case protects against roof falls, rough use. A ⅜-in. base plate with ½-in. reinforcing skid runners protects the unit when skidded over rough bottom, haulage tracks, etc., during frequent relocation.

Internal ruggedness—Core and coils braced at both top and bottom to withstand full short circuit conditions, securely mounted in case to withstand moving and rough handling.

Low height—The most compact mine power centers made, the 600-kva unit is only 42 inches high, the 300-kva unit only 36 inches.

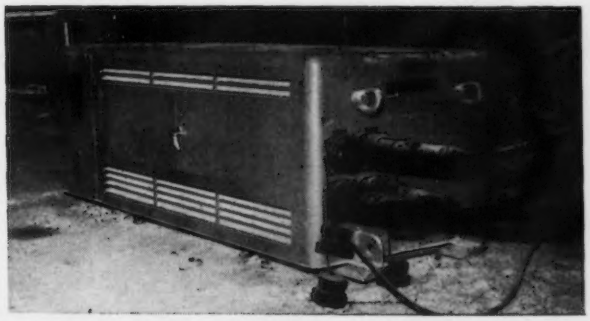
Low maintenance cost—Nitrogen-filled, sealed, dry-type power center is practically maintenance-free; protected against moisture even when de-energized during prolonged shutdowns.

This sealed mine power center is but one of the complete line of Westinghouse power centers available to serve the mining industry above the surface, as well as below. Ask your Westinghouse representative about the power center to serve your specific applications.

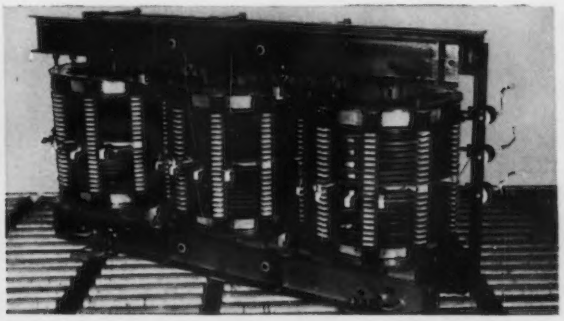
You can be sure . . . if it's
Westinghouse

Convenient location of the high-voltage receptacle on world's largest sealed mine power center permits hitching to low-voltage end when unit is skidded to a new location. This allows unit to remain energized; high-voltage cable can pull straight without bending, and buggy can obtain its motive power from one of the secondary feeders.

A full range of ratings in ventilated mine power centers is available from Westinghouse for application where conditions are less severe—such as less dust, lower humidity.



Core and coil assembly for 600-kva, 7200/480-volt, 3-phase unit—world's largest sealed mine power center made by Westinghouse.



DOW

mining chemicals

SEPARAN

SEPARAN IMPROVES SETTLING RATES UP TO 2600% IN ACID OR ALKALINE PULPS

Separan® flocculants can be relied upon to make drastic reductions in settling time on nearly every kind of suspended solid over the entire pH range. For example, it will flocculate solids effectively in 60% sulfuric acid, in leach solutions of pH 1, in neutral solutions, in hot 10% soda ash solutions, and in hot 4% caustic soda solutions.

Many milling operations have cut operating costs by using Separan to increase settling time, improve overhead clarity, and speed the filtration rate.

Separan flocculants are water-soluble polymers of acrylamide, which function most effectively at minimum dosages. And unlike some polyelectrolytes excessive amounts do *not* cause redispersion of the solids. Although no two ores are exactly alike, Separan has improved settling or filtration rates of copper, lead, zinc concentrates, and tailings. It has also proved effective in the production of potash, taconite, uranium, tungsten, manganese, barytes, coal, borax, soda ash, and ammonia-leached nickel. Complete technology is available from Dow.

IMPROVED SETTLING RATES WITH SEPARAN
(clear overflow)

	Lbs. Separan per ton of solids	Settling rate (inches/minute)		Percent improvement
		untreated	treated	
COPPER CONCENTRATES	.05	.11	.49	340%
ZINC CONCENTRATES	.03	1.82	8.0	340%
URANIUM SLIMES	.01	1.25	12.5	900%
URANIUM ORE	.10	.068	1.93	2600%

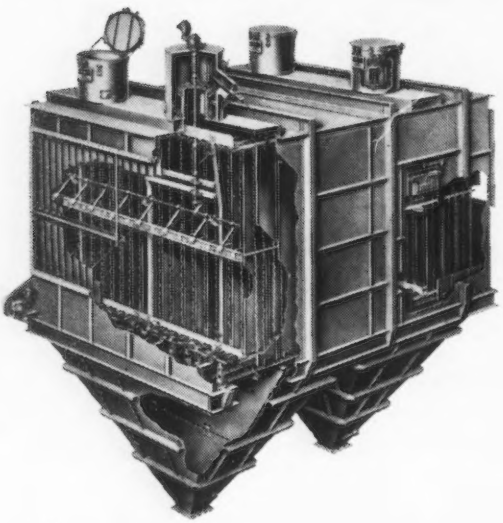
For all your mineral processing problems involving chemicals, you may obtain expert assistance from the Dow Mining Technical Service Department. To obtain technical service or our new digest, *Chemicals for the Mining Industry*, write to THE DOW CHEMICAL COMPANY, Abbott Road Buildings, Midland, Mich., Attn: Chemicals Merchandising, Dept. 750BD6.

THE DOW CHEMICAL COMPANY DOW Midland, Michigan

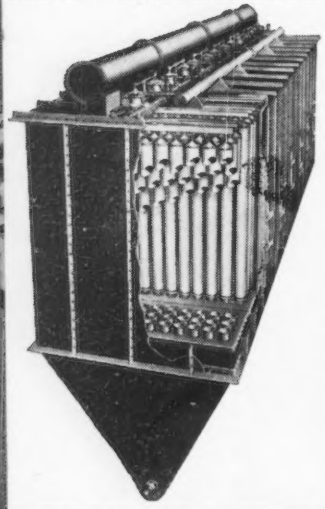
buell Norblo

DUST COLLECTION AND RECOVERY SYSTEMS

Buell-Norblo provides a complete line of high efficiency collectors for a variety of applications in every field of industrial dust collection and recovery. All equipment is engineered to your specific requirements, backed by more than 30 years of successful installations.

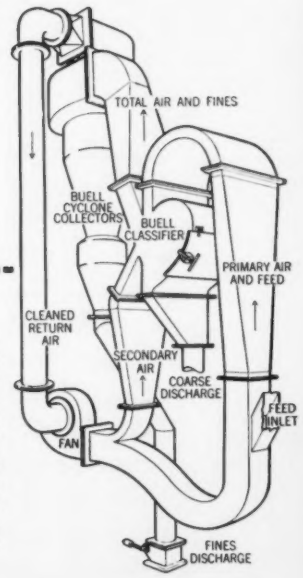


BUELL ELECTRIC PRECIPITATORS—a complete range of types for both wet and dry applications. Each precipitator is designed and sized to the specific application. For temperatures up to 700°F. Features rugged low-maintenance construction and extremely high continuous efficiency to meet most stringent air pollution codes.

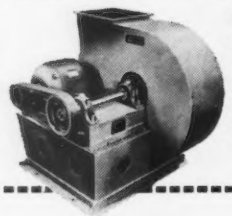


NORBLO DUST ARRESTERS—Bag collectors designed for continuous operation in heavy-duty service with extremely high collection efficiency. Available in fully automatic models for continuous service or standard and portable models for intermittent service. Compressed air or electric motor driven bag shakers. Each collector is sized and arranged for specific application, bag fabrics selected to meet temperature and dust conditions. For volumes of 100 cfm and up, temperatures to 550°F.

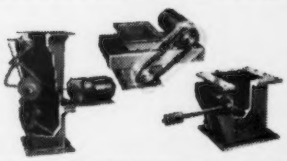
BUELL CYCLONES—Most efficient cyclone separator made, large diameter, non-plugging. Can be refractory lined for abrasive conditions. Available in single, or multiple units sized to specific application. Handles gas volume from 300 cfm up, at temperatures up to 1500°F.



BUELL CLASSIFIERS—for highly efficient separating or dedusting of dry powdered materials. No moving parts, low power requirements for draft fan. Capacities from 100 pounds to 100 tons of product feed per hour, with no practical limitations on particle size or temperature. Accurate cut points from 10 to 400 mesh size. Each installation custom engineered from 3 basic types.



NORBLO EXHAUST FANS—developed by dust collection specialists for all types of material handling. Designed for high dust loadings, 1,000 to 100,000 cfm, temperatures to 1000°F. Special protective coatings available for abrasive or corrosive conditions.



HOPPER DISCHARGE VALVES—a variety of discharge valves for automatic, intermittent, or continuous withdrawal of material.

COMPLETE SERVICE—because no two installations are exactly alike, Buell offers complete laboratory and field specialist services to determine needs, tailor proper equipment and system for top efficiency on each job. Years of experience in all types of recovery and collection installations throughout the world are at your service. Qualified field staff available for supervising installations. Your plant personnel are given complete instruction for proper operation and maintenance of equipment so that you will be completely satisfied that the desired results are obtained.

BUELL ENGINEERING COMPANY, INCORPORATED, Department 19-F 123 William Street, New York 38, New York • Northern Blower Division, 6410 Barberton Avenue, Cleveland, Ohio • Representatives in all principal cities. Consult the "yellow pages."

Strength to spare

In motor graders strength is important. Strength to withstand the shock and strain encountered in the heaviest grading jobs. In Huber-Warco graders the backbone of strength is the frame . . . it assures dependability for any job. Like those on the 8, 9, 10 and 11-D series, this all-welded, low-stress, single-member steel frame has reserve strength built in. Of full box-section design, its two steel channels are boxed together with heavy steel plates top and bottom. These two channels, which separate just behind the saddle, are further reinforced on the inside with heavy steel plates assuring strength to spare for even the most strenuous jobs. What's more, you get better visibility plus extra clearance for blade maneuverability due to Huber-Warco's high-arch design. Investigate these and the other plus features you get with Huber-Warco equipment— motor graders, 3-wheel and tandem rollers, maintainers. Your Huber-Warco distributor has all the details.

HUBER-WARCO COMPANY • MARION, OHIO, U.S.A.

HUBER W WARCO

Magnetic Equipment

for the MINING INDUSTRIES

BACKED by 40 years of magnetic research, design and engineering experience, specialists at Stearns are ready to help you select from a complete line of magnetic separation equipment the right unit for your process—or to develop a custom design tailored to your exact needs.

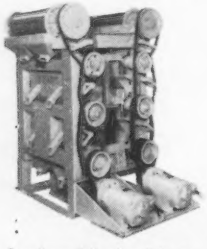
Stearns offers complete laboratory research facilities to help you solve your separation and purification problems. This includes analysis to determine the feasibility of magnetic separation, testing of sample material and recommendation of specific equipment for desired results.

Wet-Drum Separator for Taconite Concentration

The new Stearns Type WPD magnetic separator is a powerful wet-drum, permanent magnet unit designed for cobbing and roughing in taconite concentrations.

Specially designed magnet has a deep, powerful field, and provides correct flux distribution for positive transport of the collected magnetics to the discharge point. These and many other special features put the WPD separator in a class by itself for fast, low-cost taconite recovery.

Type K High-Intensity Gravity Induction Magnetic Separator

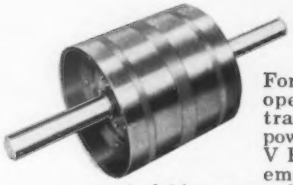


Stearns Type K magnetic separator provides an intensely powerful magnetic field which attracts very feebly magnetic particles. That is why the "K" has proved highly successful in purification and concentration application when other methods were either impractical or inadequate.

Users report that this separator has given outstanding results for magnetically cleaning or concentrating materials ranging in size from 10 to 200 mesh. Capacity ranges from 80 to over 500 lb per hr per inch of feed width. "K" separators are built in 10, 20 and 30-in. feed widths and can be furnished with from 2 to 7 magnetic fields.

Alternating-Polarity, Dry-Drum Separator

Stearns alternating-polarity, dry-drum separators are used for the dry concentration of highly magnetic materials. Because of their alternating-polarity design, they provide an unusually clean, high-grade magnetic product at a comparatively low cost. They are easy to operate, require minimum attention, and are designed for long, trouble-free service. Complete range of sizes and types to fit your needs.



Magnetic Pulleys

For high recovery in cobbing operations or for low-cost tramp iron protection, the powerful new Stearns INDOX® V Permanent Magnet Pulley employs a ceramic magnet material in an assembly with radial pole design. This provides performance equal to that of electromagnetic pulleys, but with all the cost-saving advantages of permanent magnet design. Standard sizes to fit most conveyor systems. Electromagnetic types also available.

Suspended Separation Magnet

Provides a tremendous pulling force that reaches far down into material on conveyor lines — prevents escape of deeply embedded tramp iron. Coil-wound for continuous duty. Special insulation and stainless steel coil enclosure assure fast heat dissipation. Round or rectangular construction.

INDOX is a Indiana General Corp. trademark

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Profit with Stearns — First with Ceramic Magnet Separators for Industry

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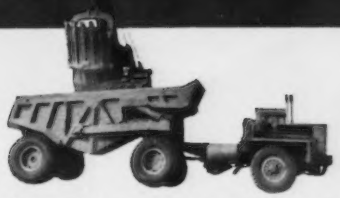
EQUIPMENT	WET-DRUM SEPARATOR	GRAVITY-INDUCTION SEPARATORS	ALTERNATING-POLARITY DRY SEPARATORS	MAGNETIC PULLEYS	SUSPENDED MAGNET
BULLETIN NO	2013-D	2091-D	2061-P	1011-D 1022-D	1032-D

WORLD'S BIGGEST PAYLOAD!



Haul 95 tons every cycle...with the **KW-DART** *95 EDT*

Today—off-highway hauling demands bigger payloads per cycle. KW-DART again meets the demand *first* with its 95 ton capacity End Dump Trailer.

Production goes *up fast*—and costs come *down*, with the 95 EDT on the job. Its KW-DART-designed transmission is performance-proved to be the finest in the field. Its rugged, universal-type hitch delivers maximum maneuverability with maximum stability.

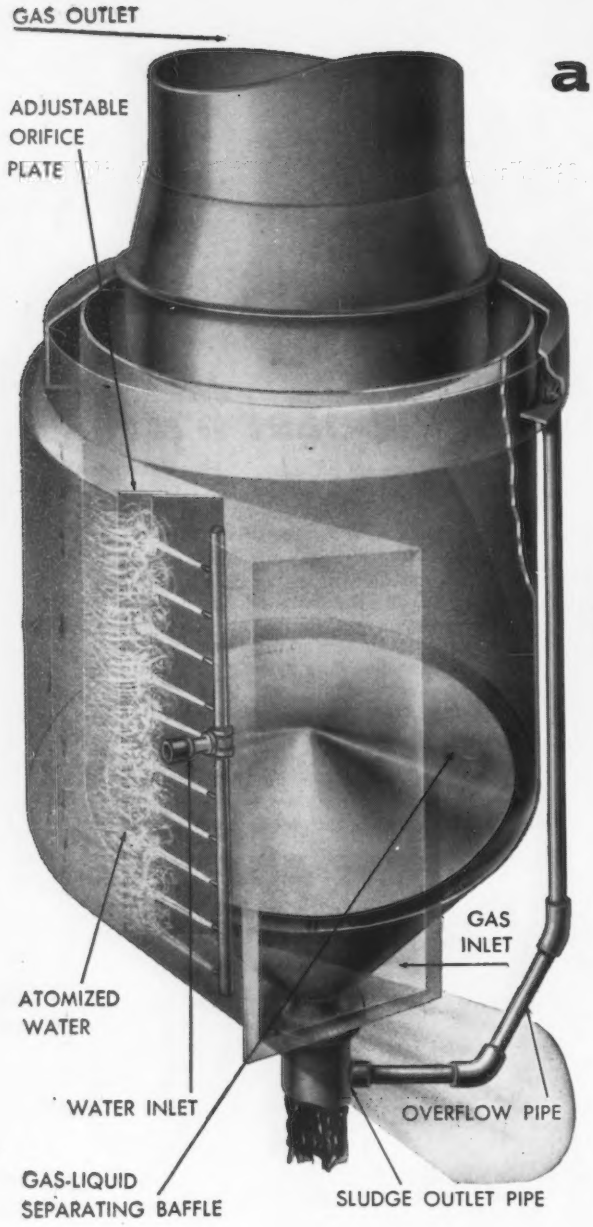
The 95 EDT does the work of three medium-size haulers in one-third the time, at one-third the operating and maintenance costs. For information on how the 95 EDT can improve your operation . . . increase your production, write . . .

KW-DART TRUCK CO.

1301 North Manchester Trafficway
Kansas City 20, Missouri

KW-DART TRUCK CO.

1301 North Manchester Trafficway, Kansas City 20, Missouri, U. S. A.



a NEW scrubber for ultra-efficient dust and fume control

THE DUCON TYPE VO Oriclone® SCRUBBER

- 50% less space requirements than other high energy scrubbers.
- Higher operating efficiency at lower horsepower.
- Adjustable orifice maintains peak efficiency when operating conditions vary.
- Economical in first cost and operating cost.
- Simplicity of design permits economical alloy construction or acid brick lining.
- 99% efficiency below 2 micron and in sub-micron range.

The Ducon Type VO Oriclone Scrubber—the only high energy scrubber with an adjustable orifice—is the most effective and most economical dust and fume collector for a wide range of industrial applications, including recovery of catalyst dust, cupola dust and fumes, acid mists, tar fog and many others.

The Oriclone Scrubber is a completely integrated unit that performs the entire separation cycle. No subsequent collector is needed.

Send today for detailed information on Oriclone.

the name in DUst CONtrol

DUCON — DUST CONTROL SYSTEMS AND EQUIPMENT

Patent Pending

THE Ducon COMPANY INC.
147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

Canadian Branch:
THE DUCON COMPANY of CANADA, Ltd.,
1131 Pettit St., BURLINGTON, ONTARIO

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

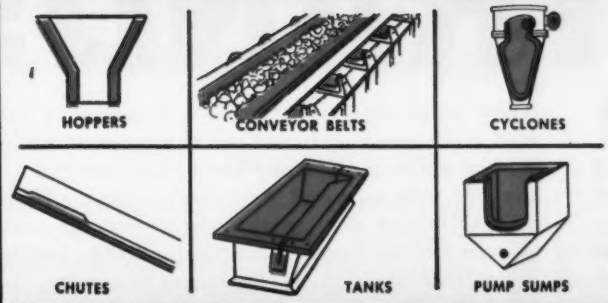
LINATEX®

LASTS LONGEST

CUT COSTS

NOW-LINATEX

DEFEATS ABRASION AND CORROSION IN MINING-EVERYWHERE!



TYPICAL DOLLAR-SAVING APPLICATIONS

Complete information on Lining with LINATEX: Specific recommendations for your particular problems: representative in principal areas: or

Write for additional Information

LINATEX

CORPORATION OF AMERICA

P.O. DRAWER "D" STAFFORD SPRINGS, CONN.

to stay in the black... Specify Leschen

RED-STRAND!

Black . . . the most attractive color in bookkeeping. There's no magic formula for staying in the black, but careful consideration of the right type and make of wire rope can cut costs substantially—10%, 20% or more.

RED-STRAND users are accustomed to longer-than-expected wire rope service, because higher-than-catalog-rated quality is built into the rope. They know that Leschen distributors and field men make sure they have the best rope construction for the job at hand. They know, and you can too, that for wire rope and sling needs—specify RED-STRAND and stay in the black! For the name of your nearest Leschen distributor write: Leschen Wire Rope Division, H. K. Porter Company, Inc. 2727 Hamilton Avenue, St. Louis 12, Mo.

PORTER

LESCHEN WIRE ROPE DIVISION
H. K. PORTER COMPANY, INC.

THREE OF THE MOST WIDELY USED Republic Roof Bolts, left to right, are: square head bolt with RS-1 expansion shell, forged steel wedge head bolt with cast rigid expansion shell, square head bolt with RE-3 bail type expansion shell. Other designs are available to meet particularly unusual requirements.

WHICH REPUBLIC ROOF BOLT IS BEST FOR YOUR MINE CONDITIONS?

In the past fifteen years, as roof bolting really came of age, two important facts became apparent. First, no one bolt is versatile enough to meet all mine roof conditions. Second, in making a selection, a precise knowledge of the effectiveness of various bolt designs when used in different types of strata is needed.

Republic helps you solve both problems. Buy Republic and you choose from the largest selection of roof bolts available anywhere. And field trained Republic Mine Roof Bolt Engineers work with you in selecting or developing a bolt that exactly fills your requirements... *the best bolt for your mine.*

Completely Automated Production Facilities keep costs down on Republic Roof Bolts. This, combined with quality that is certified (every shipment includes a certificate stating specific physical properties of the steel used), means predictable, top performance at the lowest cost.

For complete information on Republic Mine Roof Bolts and obligation-free Roof Bolt Field Service, send the attached coupon.

REPUBLIC STEEL

REPUBLIC HAS THE FEEL FOR MODERN STEEL

Steel

Strong
Modern
Dependable

REPUBLIC'S NEW PLASTIC SHELL CASE

PROTECTS SHELLS IN STORAGE—SIMPLIFIES HANDLING AND INSTALLATION. The new shell case is unaffected by moisture and corrosive conditions often present in mine storage areas—protects against shell damage and lost parts. The plastic case can be left on the shell when installed, makes installation faster and easier. Standard on all Republic Bail-Type Roof Bolts at no extra cost.

REPUBLIC STEEL CORPORATION
DEPT. EJ-1809-B
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Please send further information on:
☐ Republic Roof Bolts
☐ Republic Roof Bolt Field Service

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

The Ni-Hard iron liners in this rod mill have saved over $16,000. Cost per ton of ore dropped to 0.89 cents, compared with 2.50 cents per ton for manganese steel liners formerly used.

In this rod mill 2 years . . .

Ni-Hard liners save over $16,000

Two years ago, Canadian Malartic Gold Mines installed Ni-Hard* nickel-chromium white cast iron liners in their rod mills. A profitable move: in grinding 933,000 tons of abrasive gold ore, Ni-Hard iron liners have saved over $16,000.

2 years' service, only 20 hours downtime. This cost-cutting performance is due to the outstanding abrasion resistance of Ni-Hard iron. Not only is its structure as hard as fully hardened steel, but it contains firmly embedded hard carbides which help it withstand particularly abrasive punishment.

You can slash costly downtime and increase the efficiency of your mill operation by specifying Ni-Hard liners. They can double or triple the intervals between mill relinings, often holding their original contour right down to the last quarter-inch. Labor and maintenance costs are also minimized with Ni-Hard liners.

Contact your Ni-Hard producer and arrange to try a set of Ni-hard liners in your mills. He can also give you valuable information on this wear-resistant nickel-alloyed cast iron for other parts used in ore processing equipment — such as feed spouts, pipe elbows and fixtures, slurry pump liners, impellers and wear plates.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

NI-HARD

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

"JFI Positive Performance Feeder cuts costs six ways at Wyatt-Seanor Mine."

Says John Harvey, Superintendent, Wyatt-Seanor Mine, Simpson Coal and Chemical Corporation.

Simpson Coal and Chemical increased production *and cut costs* when they installed a JFI *positive performance* Feeder in their Wyatt-Seanor Mine in Western Pennsylvania. John Harvey, Wyatt-Seanor Superintendent, reports: "The JFI Feeder allowed us to more fully utilize belt capacity by conveying more coal at slower belt speeds—100 f/p/m *less* than before. Belt wear was noticeably reduced.

"We were also able to eliminate mainline belt spillage from the feeder point to the outside of our mine, and now there is no need to attend belt transfer points. Many man hours are being put to use at more productive jobs. Elimination of surges and overload conditions has reduced mechanical maintenance on belt drives and cut horsepower requirements on those drives."

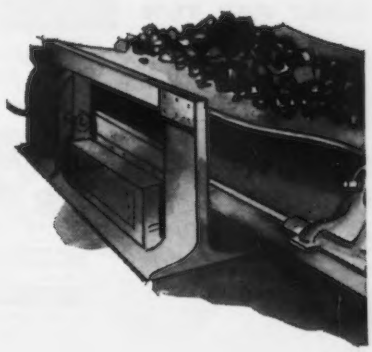
JFI *Positive Performance* allows high shuttle car discharge rate, complete flexibility of reduction ratio, and profitable multiple belt operation. Feeders are available for both coal and ore mining operations.

If you're after increased production at lower cost, check JFI's complete design and advisory service.

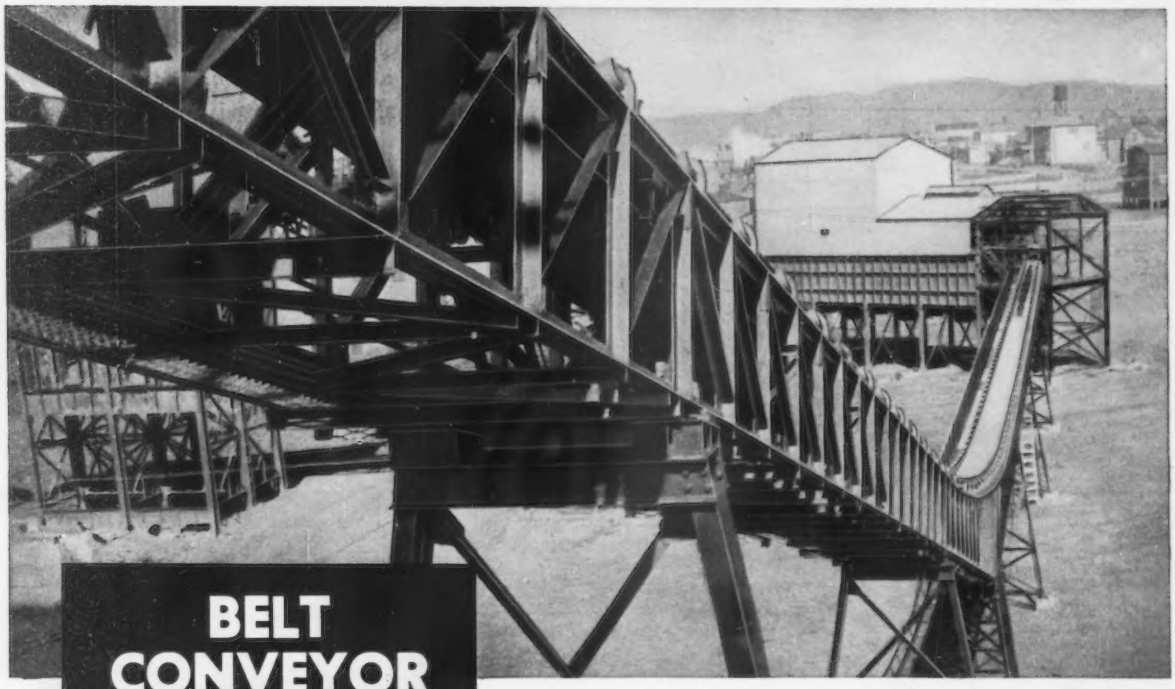
Write today for free literature.

JAMISON FEEDER, INC.

HUNKERS, PENNSYLVANIA TELEPHONE: WAlker 5-7200



STEPHENS-ADAMSON



BELT CONVEYOR SYSTEMS

provide efficient, uninterrupted, continuous flow of bulk materials

As the photographs on this page so graphically illustrate, bulk materials are carried in a continuous uninterrupted flow. Efficiency is increased, while increased tonnages are handled at the lowest cost per ton. STEPHENS-ADAMSON Belt Conveyor Systems master problems of geography, weather, distance and terrain. Loaded conveyor belts move material to and from processing, storage, crushing, sampling and reclaiming operations. Whether bulk materials are large chunks such as run of mine ore, pulverized as in chemicals or small granular size as in sand, S-A Belt Conveyor Systems handle them with equal ease and efficiency. You'll be bulk materials handling profit dollars ahead when you specify or recommend S-A Belt Conveyor Systems. Get full details today.

S-A BELT CONVEYOR SYSTEMS HANDLE GREATER TONNAGE AT LOWEST COST PER TON

STOCKPILING—S-A Stocker Boom Conveyor discharges to stockpile.

STORAGE—S-A Belt Conveyor Tripper feeds storage pile.

RECLAIMING — S-A Belt Conveyors reclaim material from storage piles.

WRITE FOR LITERATURE

S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
TRAMMASTER® TAIL BEARING UNITS
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ENGINEERING DIVISION

STEPHENS-ADAMSON MFG. CO.

GENERAL OFFICE & MAIN PLANT — 4 RIDGEWAY AVE., AURORA, ILL.

PLANTS LOCATED IN: LOS ANGELES, CALIF. • CLARKSDALE, MISS. BELLEVILLE, ONT. • MEXICO CITY, D. F.

CABLE DAMAGE PROBLEM? THIS COLORED JACKET CAN HELP YOU!

Phelps Dodge Tufply Cable

Phelps Dodge TUFPLY portable cable is now available with a brightly colored jacket that has been found to be most effective in prolonging cable life by reducing cable damage. First used and proven in Phelps Dodge's own mining operations, the colored outer jacket helps prevent needless damage to the cable by making it clearly visible to equipment operators. As a result, the service life of the cable with this colored jacket is greatly increased.

TUFPLY portable cable represents years of Phelps Dodge mining "know-how" combined with many years of cable manufacturing experience. Made of highest quality copper from Phelps Dodge's own open-pit mines, the cable assures utmost protection and finest performance in both above and below ground mining projects. TUFPLY is listed by the U. S. Bureau of Mines; approved by the Dept. of Mines, Commonwealth of Pennsylvania, P-114-BM.

First for Lasting Quality—from Mine to Market!

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CORPORATION
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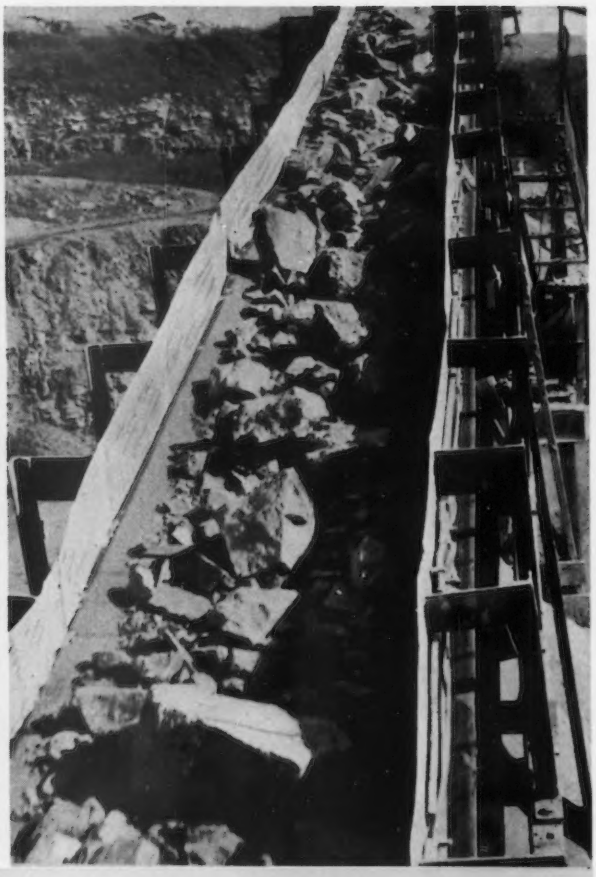
P D MINE TO MARKET



Acme-Hamilton introduces "Hy-Impact" Conveyor Belt with "Shock-Weve"!

Over 500,000 tons of rock have been hauled from the primary crusher on new "Hy-Impact" belt at each of three well known plants across the country where 200,000 to 250,000 tons of rock hauled on regular belt was considered normal service life before replacement. For the past two years, Acme-Hamilton has been testing this completely new belt at these plants. To date they have hauled over 500,000 tons each without downtime due to damage, resplicing or replacement. Examination by engineers shows an expected service life of several hundred thousand more tons.

New "Shock-Weve" fabric construction is responsible for this overwhelming service life. Priced the same as conventional belting, "Hy-Impact" reduces cost by half or more because of its doubled service life. Write for more information about this new money-saving belt today. Dept. B-H.

Acme/Hamilton

MANUFACTURING CORPORATION, TRENTON 3, N. J.

Industrial and Automotive Rubber Products Since 1870

ATLANTA • CHICAGO • DETROIT • HOUSTON • SAN FRANCISCO • INDIANAPOLIS
NEW YORK • SEATTLE • MILWAUKEE • PITTSBURGH • SALT LAKE CITY • LOS ANGELES

New General Electric
SCR Static Control
Now in Operation

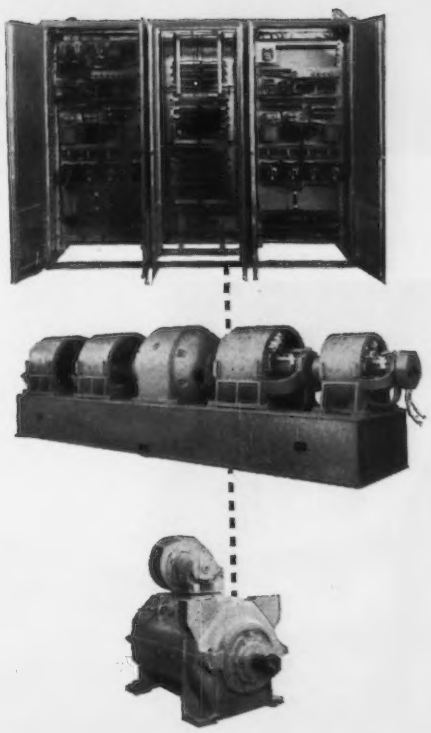
SETTING NEW DIGGING STANDARDS

General Electric and Marion Power Shovel Company announce a significant advance in shovel performance—a BIG loading machine with superior dynamic response to all digging requirements.

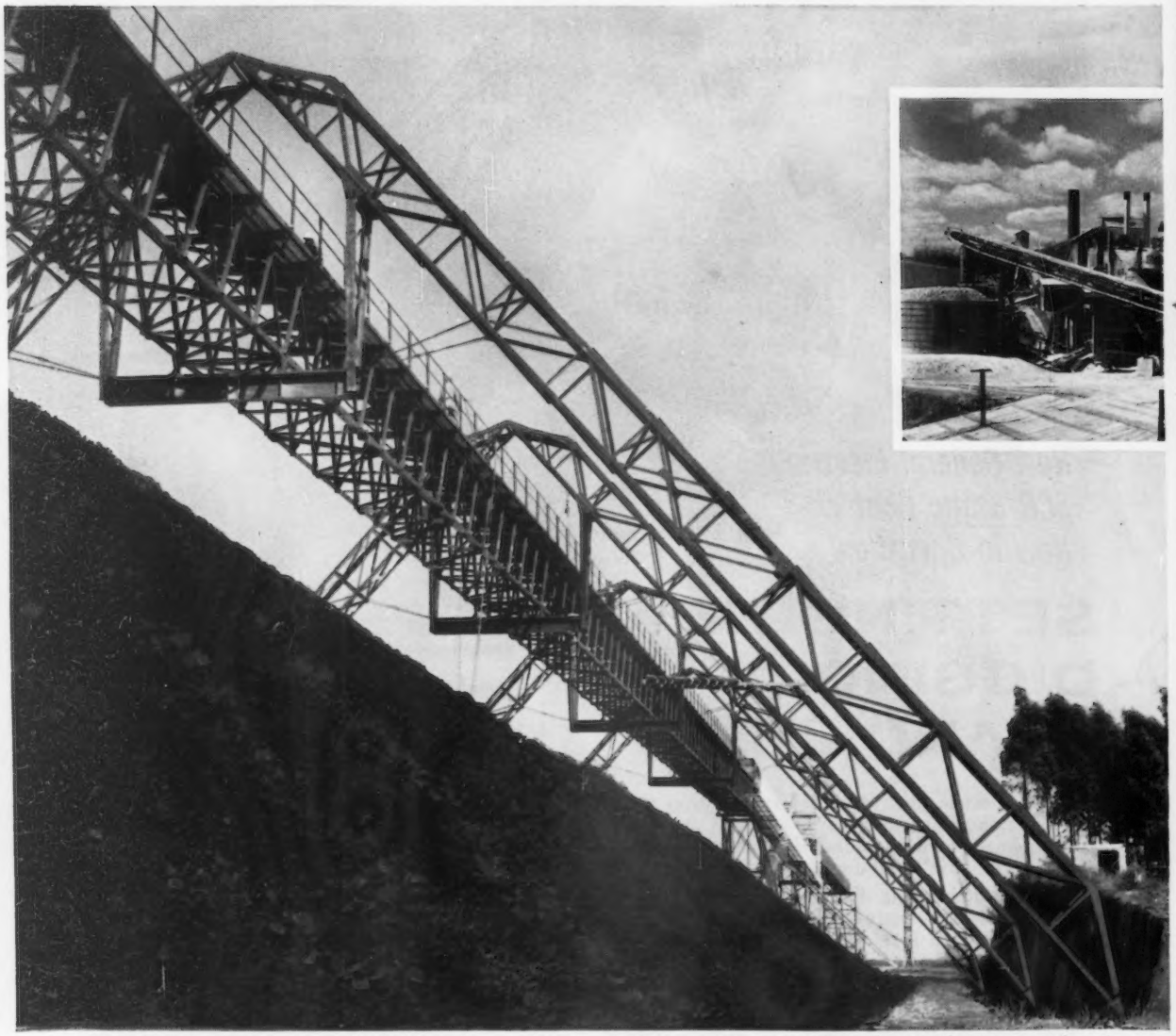
To meet demanding digging conditions of Taconite ore, Marion engineers and General Electric jointly developed and applied to Marion's 191-M machine, the first *Silicon-Controlled rectifier, full power, full reversing, control system* ever applied to a Marion machine.

Featuring no moving parts and almost instant response, the new SCR control system was "design proven" on a computer before manufacture. Next came extensive equipment tests at General Electric's Erie, Pennsylvania, plant. The complete shovel then underwent actual field testing in the pit, to assure *full customer satisfaction*. The 191-M is now in actual production digging. System-engineered with G.E.'s rugged direct current MD shovel motors and reliable d-c motor-generator sets, the new SCR system minimizes the effect of current overshoot under such dynamic conditions as boulder shock, for maximum protection and minimum maintenance of the entire shovel system. Designed for low maintenance and backed by nationwide service facilities, the new shovel drive system offers minimum downtime and maximum performance under the most severe digging conditions.

For complete information contact your nearest General Electric Industrial Sales Office or write General Electric Co., Section 827-07A, Schenectady 5, New York.



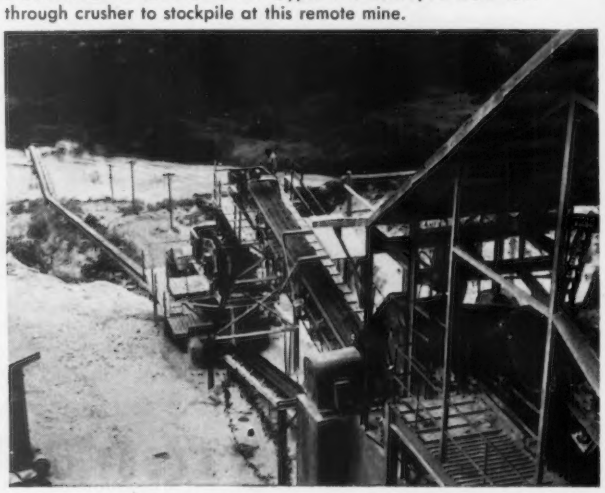
GENERAL ELECTRIC



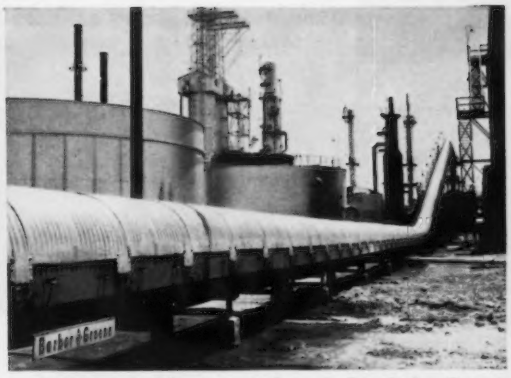
URUGUAY. Manganese ore is unloaded from ships, stockpiled, and reclaimed at this shipping terminal by a 2,655' Barber-Greene conveyor system. Notice the giant hurricane-proof cantilevered supports that clear this stockpile and under which the stockpiling conveyor is hung.

SOUTH AMERICA. Barite moves two ways on this reversible conveyor, from ship to stockpile, and from stockpile to ship.

DOMINICAN REPUBLIC. Gypsum is conveyed from face through crusher to stockpile at this remote mine.



MISSOURI. Dolomite flows from mine through crushers and screens to stockpile on Barber-Greene conveyors.



COLORADO. Gilsonite travels over five Barber-Greene conveyors through processing at this plant. The 487′ unit shown carries the wet materials from the filter plant to the melt tank.

MINNESOTA. Iron ore gets a fast ride from hopper cars to beneficiation plant on this heavy duty Barber-Greene conveyor.

WHY MINE OPERATORS SPECIFY BARBER-GREENE CONVEYORS

Decades of dependable service plus imaginative design wins favor with heavy material movers in all corners of the globe

World-wide acceptance of heavy duty Barber-Greene belt conveyor systems has been earned by decades of dependable on-the-job performance in mines around the world that stamp these conveyors as the most economical way to move bulk materials.

Big reasons why decades of profitable use are built into all Barber-Greene conveyors include: 1) 45 years of manufacturing experience that produces the finest conveyor components your money can buy; and 2) a conveyor engineering team that draws on the most complete stock of standardized components and the most imaginative design in the industry to make every job a blue chip materials handling investment.

Actually, many customers report substantial savings in the cost of their original conveyor systems because of Barber-Greene design innovations that were not produced by any other manufacturer bidding on their conveyors.

And Barber-Greene offers another plus that keeps your materials moving—a world-wide distributor network that makes replacement parts or additions to the system immediately available anywhere. That's a money maker whether your conveyor operates in this country or the remotest corner of the globe.

Put your Barber-Greene Conveyor Representative to the test on your next heavy duty, high capacity conveyor system. You'll get a fast money saving quotation, fast delivery, expert field erection service, or complete erection drawings, whichever you prefer. And you can count on the special attention it takes to get your conveyor moving on or ahead of schedule.

MEMBER CEMA CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION

Your belt conveyor equipment headquarters

Representatives in Principal Cities of the World

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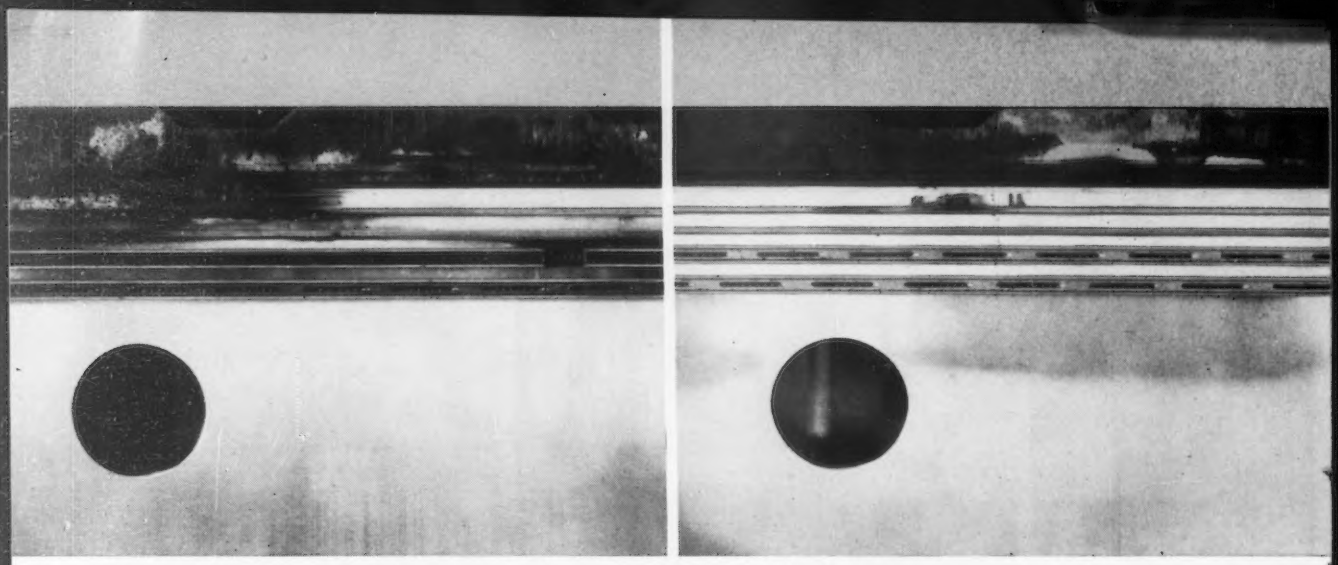
CONVEYORS • LOADERS • DITCHERS • ASPHALT PAVING EQUIPMENT



Left: Poor performance of competitive diesel lubricant is easily noted on piston rings.
Right: Superior cleanliness—typical of Shell Rimula Oil performance.

BULLETIN:

Shell reveals how Rimula Oil saved a road construction company $37 per diesel engine on each drain period

A leading road construction company tested Rimula® Oil on a freeway job.

Object: to find an oil that would overcome two key problems in its heavy-duty diesel operations.

1. Heavy engine deposits. 2. Short oil drains.

Read how Shell Rimula Oil tackled these problems, kept the project moving at high speed—and helped to cut overhead.

A LEADING road construction company was having two costly problems with its supercharged diesel engines. Deposits were impairing engine performance. Oil drains were required every 80 hours—far too often for economical operation.

To fight these problems, the company switched to Shell Rimula Oil. After 2000 hours of operation in these same diesel engines, the oil's performance was evaluated.

The company's lube foreman reports these cost-cutting results:

1. Improved engine performance. Shell Rimula Oil greatly reduced lacquer and valve deposits.

Valve mechanisms, bearings, pistons, rings and crankcase were notably free of deposits.

Higher engine efficiency helped the company meet production levels and hold to its maintenance budget.

2. Longer drain periods. With Shell Rimula Oil, the 80-hour drain period was extended to 400 hours. Five times as long.

This saved $37 on labor and oil costs alone, on each engine, each drain period.

Gasoline engines cleaner, too

Shell Rimula Oil has shown some impressive results in gasoline engines, too.

It is well suited for use in gasoline-powered trucks in severe service. If used exclusively, Shell Rimula Oil helps assure clean engines.

For complete data about Shell Rimula Oil, contact your Shell Industrial Products Representative. Or write: Shell Oil Company, 50 West 50th Street, New York 20, N. Y.

SHELL

A BULLETIN FROM SHELL
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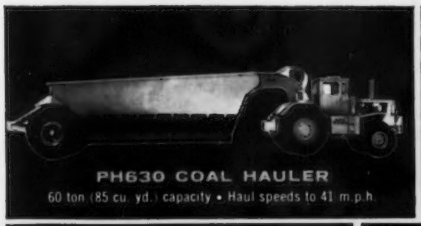
***Lower your hauling cost per yard with* 6**

NEW ATHEY TRAILERS

...bonus payloads, high speed performance, new power!



PH630 COAL HAULER
60 ton (85 cu. yd.) capacity • Haul speeds to 41 m.p.h.

PR630 REAR DUMP
40 ton capacity • Speeds to 41 m.p.h.

PW631 BOTTOM DUMP
45 ton (30 yd. struck) capacity • Speeds to 31 m.p.h.

PR631 REAR DUMP
40 ton capacity • Speeds to 31 m.p.h.

PW630 BOTTOM DUMP
48 ton (32 yd. struck) capacity • Speeds to 41 m.p.h.

PR619 REAR DUMP
"T-1" Steel Construction • High maneuverability

Each new Athey trailer is designed and built to give better performance than comparable sized units. Pound for pound they're tougher, stronger and built to do a man-sized job. "T-1" steel construction eliminates profit robbing dead weight... gives increased capacity without increasing gross weight or reducing performance.

New Caterpillar* 630 and 631 Tractor power ...420 horsepower gives power to spare! Power Shift Transmission—9 speeds with 3 shifts and no clutch! Other new Athey features include constant running gear type pumps; flared, open-mouthed bodies; low slung design for efficient shovel loading; straight-line body design for fast discharge of any material.

Write for details. A big new booklet gives the facts about Athey's new high capacity trailers. Request "PAYLOAD... POWER... PERFORMANCE!"

Athey PRODUCTS CORPORATION • 5631 WEST 65TH STREET • CHICAGO 38, ILL.
Designers and manufacturers of heavy-duty loading and hauling equipment.
*Caterpillar and Cat are registered trademarks of Caterpillar Tractor Co.

Athey
T-LINE TRAILERS

EXPLORING OR MAPPING...

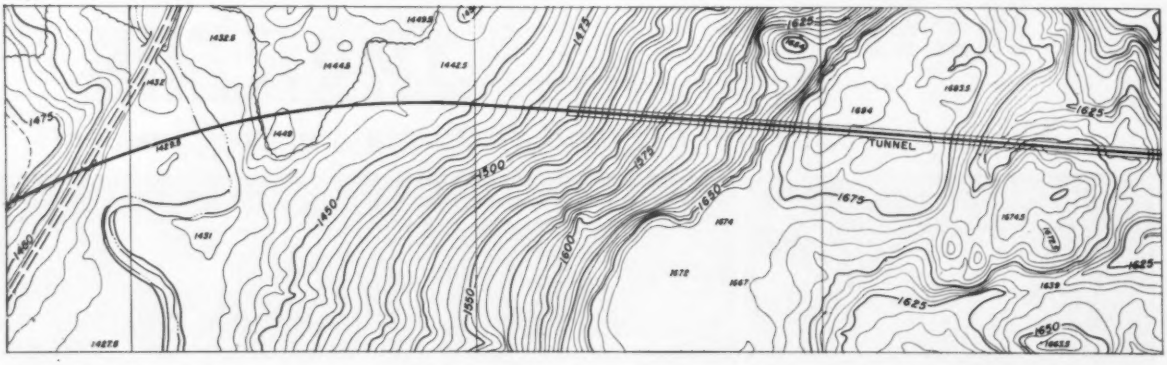
AERO SERVICE SPEEDS THE JOB!

FOR EXAMPLE: *A search for sulphides in New England*

PROBLEM: Exploration for sulphide ores in brush-covered, hilly New England area.

SOLUTION: Helicopter-borne magnetometer and electromagnetic detector survey by Aero Service Corp. Survey was flown at tree-top level, gave maximum detailing.

SAVING: Comparison of magnetic record and of in-phase and out-of-phase EM signals permitted full and rapid evaluation of magnetic and electromagnetic anomalies, saving ground work. The correlated air survey information pin-pointed the ground targets to be studied in greater detail.



FOR EXAMPLE: *Location of a mine railroad in Minnesota*

PROBLEM: Location of a 75-mile railroad over swamp and brush-covered area from Hoyt Lakes, Minnesota, to Lake Superior port.

SOLUTION: Aerial photographing, mapping, and photo interpreting by Aero Service Corp. Final location of railroad was made with five-foot contour-interval map, shown above, with a horizontal scale of 1 inch: 200 feet.

SAVING: Complete surveying, mapping, and location work was finished in 1½ years, with construction contracts for the railroad executed and in active progress less than two years after the first planning.

Whatever your mapping or airborne geophysical exploration need —anywhere in the world—Aero can speed your project. Our services include photo and topo maps, airborne magnetic and electromagnetic surveys. Write for Aero's report on how to cut costs and save time. We shall be glad to meet with your staff, to discuss specific projects.

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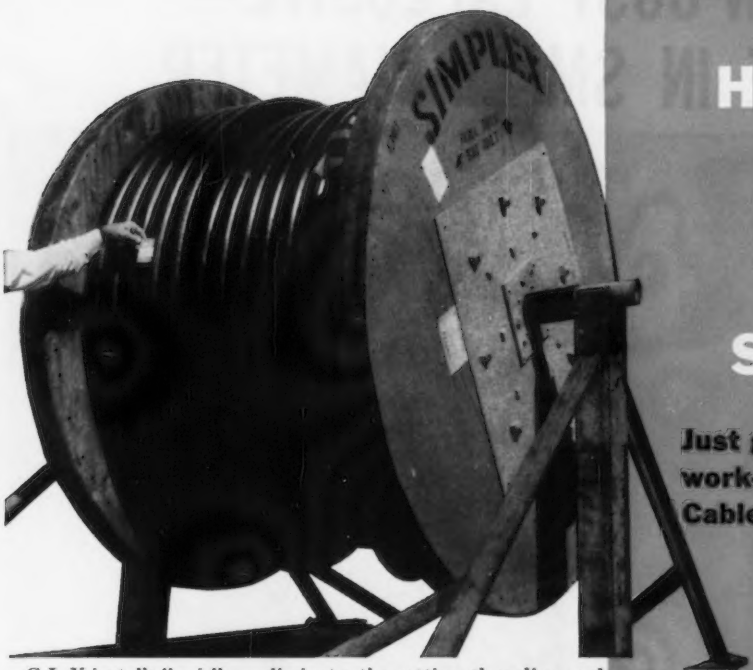


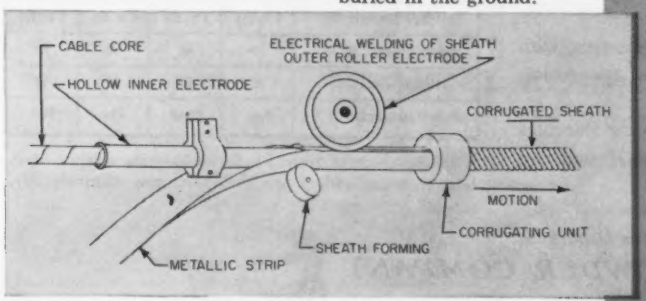
C-L-X installs "as is" . . . eliminates the cutting, threading, and pulling operations necessary with conventional duct or conduit.

C-L-X is pliable . . . can be handled smoothly on a standard size reel.

C-L-X is easily trained anywhere, in continuous, long-length runs.

C-L-X installs without the need for benders, sand, elbows, or similar fittings.

C-L-X is versatile. It can be installed with clamps, in trays or ladders, or directly buried in the ground.



How C-X-L is made.

HOW MUCH MONEY COULD C-L-X SAVE YOU?

Just glance at these time-and-work-saving features of C-L-X Cable Systems by SIMPLEX.

You'll see how easily this packaged *combination* of cable and pliable, impervious metallic sheath installs. You'll see why it cuts installation cost to a fraction of that required for conventional cable and duct. Then *find out* how much money today's easiest-to-install cable system can save you.

C-L-X is available with plastic-jacketed sheaths of steel and with sheaths of aluminum, bronze, or copper — with or without plastic jacket. It's the choice of chemical plants, oil refineries, paper mills, utilities, industrial plants — wherever severe environmental conditions exist. Write today for your free, illustrated brochure on C-L-X.

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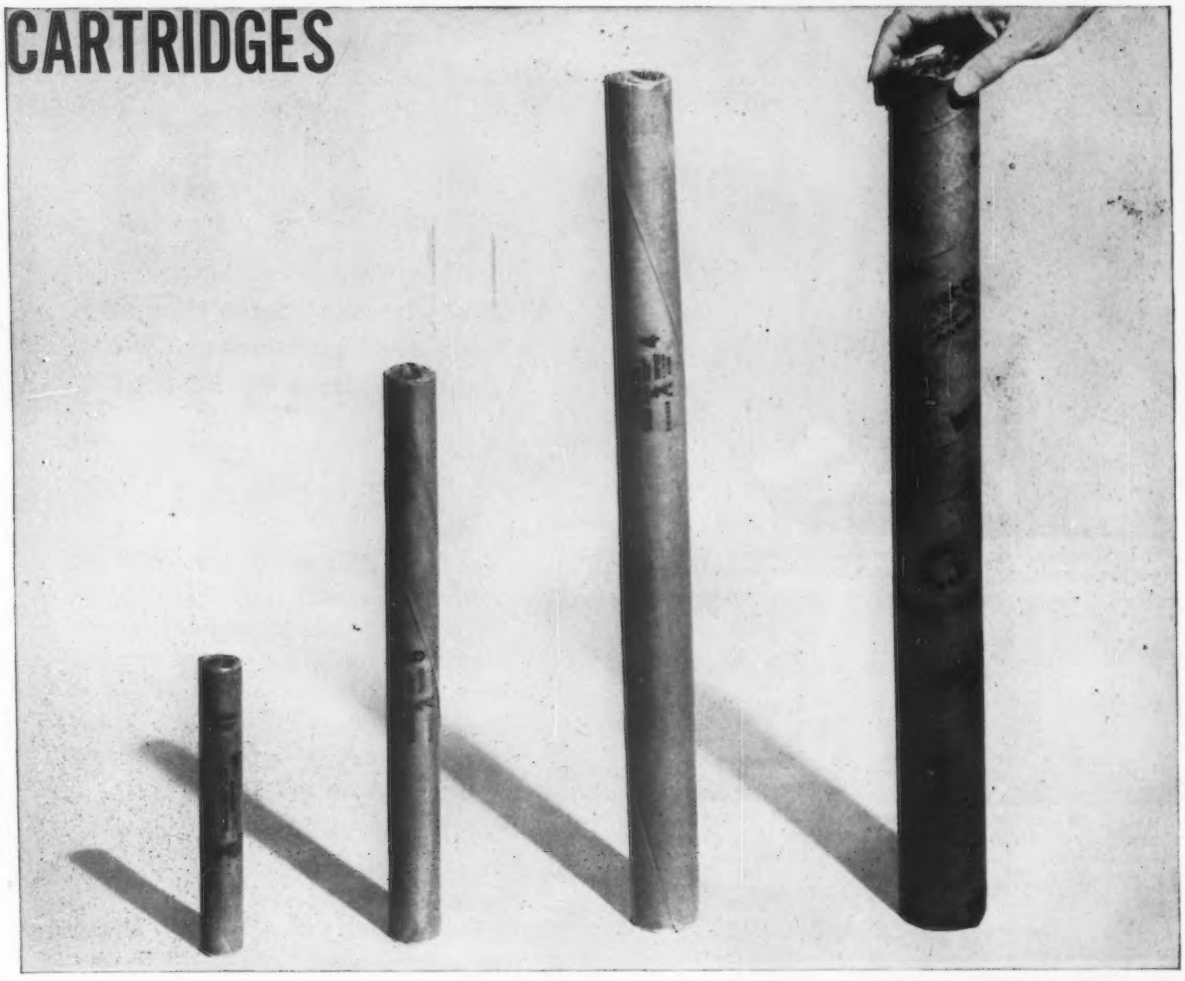
WIRE & CABLE CO.
Cambridge, Massachusetts • Newington, N.H.

HERCOL®—A LOW-COST EXPLOSIVE—NOW AVAILABLE IN SMALL-DIAMETER CARTRIDGES



The Hercol series of low-cost, cap-sensitive, high-ammonia-content explosives are now available in cartridges of small diameters and standard lengths, as well as in the larger diameters and special packings.

The ability of Hercol to produce excellent fragmentation, its water resistance, Class 1 fumes, and high cartridge count—plus its low cost—have already been proved to the economy-minded quarry and open-pit operator.

Now that Hercol is manufactured in the smaller diameters, with Class 1 fumes, these same economies are available to the underground operator.

Contact the Hercules sales office nearest you or ask your Hercules representative for more detailed information on how Hercol can reduce blasting costs for you, too.

Properties of Hercol

	Hercol	Hercol 2	Hercol 4	Hercol 6
Fumes	Good	Good	Good	Good
Cartridge count—1¼ by 8-in. cartridges per 50 lb.	130	120	140	165
Cartridge diameter, in.	4 to 8½	1 to 3½	1 to 3½	1 to 3½
Weight strength, %	70	68	68	68
Cartridge strength, %	48	50	34	19
Water resistance	Fair	Good	Fair	Fair

A special grade of Hercol is formulated for seismic "pattern shooting" when the drill-holes are relatively dry.

Explosives Department

HERCULES POWDER COMPANY

INCORPORATED

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IRON NUGGET with a BRIGHT FUTURE

IRON ORE BENEFICIATION to provide concentrated blast furnace feeds is assuming increasing importance in steel manufacturing.

As designer, engineer and constructor of plants for the production of enriched ores, Bechtel is taking a leading role in this development, currently is at work on beneficiation projects in the United States and Canada.

- Experience covers many of the newer as well as all of the basic metals, and facilities that range from open pit mines to metal forming plants.
- Services meet *all* project requirements—feasibility studies, design, engineering, procurement, construction or construction management.

BECHTEL CORPORATION

Engineers and Builders for Industry

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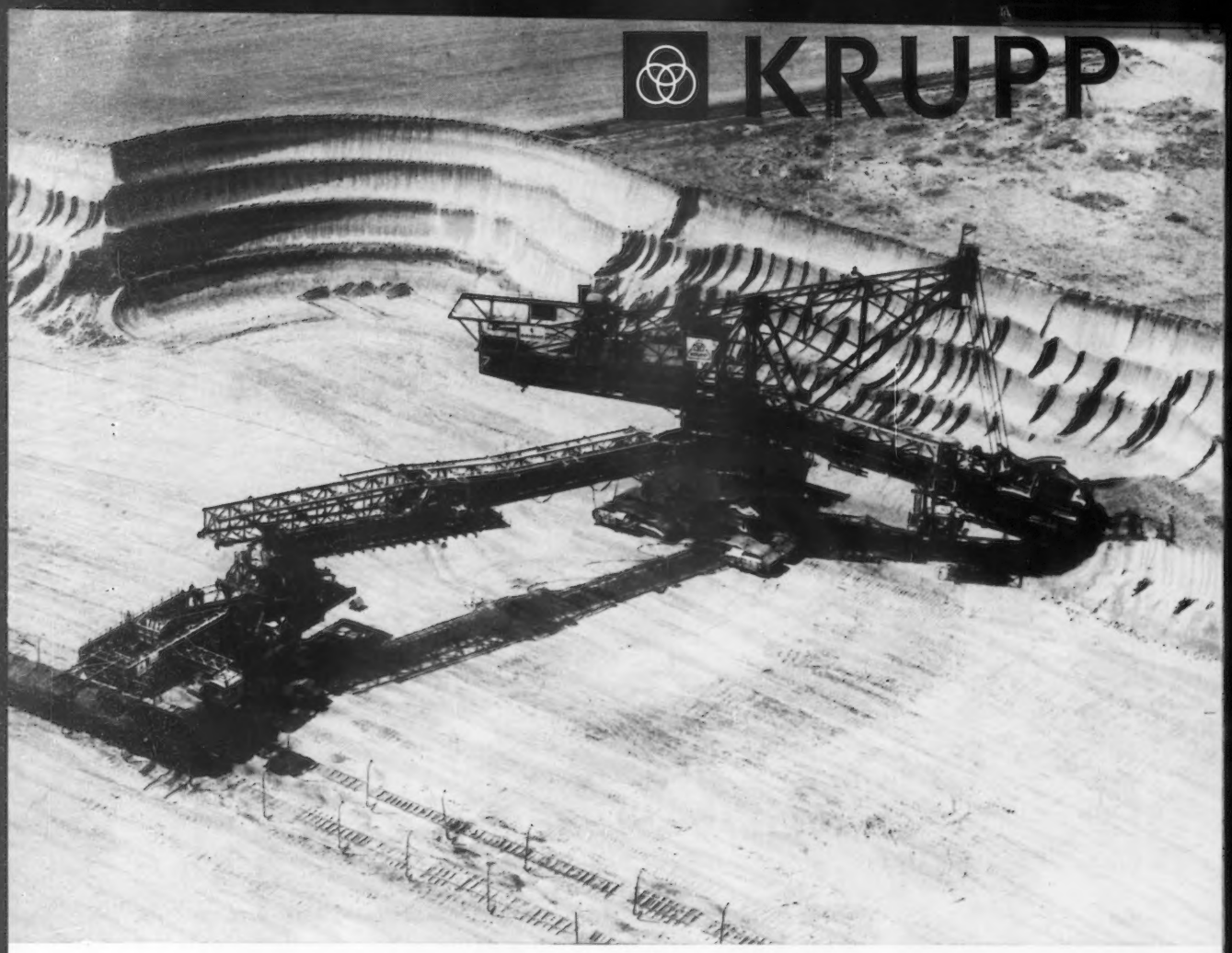
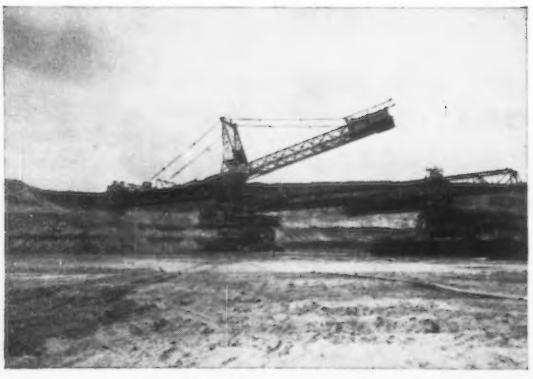


Bucket Wheel Excavators with loading units moving independently ensure a high performance with large stripping block widths of 300 feet and more.

We advise on all projects involving mining of materials and their transportation. We design complete surface and underground mining schemes and the necessary mechanical equipment based on the manifold experiences of our mining, excavation and conveyor engineers.

We design, manufacture and erect excavators, either rail or crawler mounted, for mining, canal and dam construction, etc., such as bucket chain excavators, bucket wheel excavators, loaders, spreaders, stackers, special equipment, complete bunkering plants, conveyor bridges, stationary and movable conveyors.



Large KRUPP Bucket Wheel Excavator,
with loading unit mounted on separate crawler tracks.

Daily output rate:	200,000 cu.yds.
Maximum cutting height:	164 feet above track level
Maximum cutting depth:	16 feet below track level

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For information, please contact Krupp International Inc., 375 Park Avenue, New York 22 N. Y.

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An example of Avisco Rayons in Industry

Now, stronger, lighter-weight belts with Avisco XL-I rayon

Because of fabrics made from Avisco XL-I rayon fiber it is now possible to engineer stronger, lighter-weight belts.

Compared to the traditional fiber, fabrics of XL-I rayon have up to 60% greater tensile strength and 3 to 5 times the fatigue life.

XL-I rayon adheres without predipping. Flex characteristics are excellent. XL-I fabrics trough well, conform better to pulleys and rollers, readily absorb starting and shock loads. Their lighter weight requires less power for starting and running.

For help in improving your product with Avisco XL-I rayon reinforcement, send in the Quick Reply Coupon.

QUICK REPLY COUPON 3-19

Industrial Merchandising Division
American Viscose Corporation
350 Fifth Avenue, New York 1, N. Y.

Please contact me about Avisco Rayons for use in the following application:

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Name_____

Company_____

Address_____

City_____ Zone_____ State_____

AVISCO® AVISCO® RAYON

AMERICAN VISCOSE CORPORATION, 350 Fifth Avenue, New York 1, N. Y.

EXPLOSIVES

At this Maryland quarry, Ammodyte,® a low-cost cartridged explosive, was used to obtain maximum fragmentation and displacement of this tough, blocky granite gneiss. In the large photo above, notice how the toe is sweeping clear, resulting from well planned bottom initiation with Rockmaster® millisecond delay electric blasting caps. The resulting muck pile is properly laid out for easy, efficient digging.

ENERGY...

Are you aware of the many ways it is cutting costs all along the line? . . . Boosting production? . . . Increasing life of heavy equipment? . . . Allowing more efficient use of total man-hours?

Cheaper blasting materials, new blasting techniques, and improved drilling equipment, have reduced the cost of explosives energy to the point where it is doing work formerly reserved for mechanical equipment. And doing it cheaper, faster, and more efficiently.

In the Maryland quarry shown here, achieving good breakage was a difficult problem. This granite gneiss is tough and blocky. And production demands couldn't wait for drop balling or a blocked crusher. Working with the Atlas Representative, these profit-minded operators modernized their blasting techniques.

By adjusting hole diameter, burden and spacing, and utilizing the wallop of low cost Ammodyte,® these operators are gaining breakage and displacement never achieved before. Production speeds have been increased because they have been able to dig shots quicker and easier and gain maximum crusher production. In the process, they are realizing real savings in maintenance and wear on crusher, dipper teeth, wire rope, and truck bodies.

In coal stripping, other alert, up-to-date operators are using explosives energy to accomplish new tasks. Explosives force is being used to move up to 50% of the overburden directly onto the spoil pile. Mechanical handling costs are reduced, coal is uncovered more rapidly.

In open pit ore mining, explosives factors are being designed to gain additional fragmentation. Much of the material by-passes the primary crusher. Production is speeded, overall costs lowered.

In construction, contractors are finding that explosives energy can save them unwelcome maintenance costs on valuable equipment, and accomplish work faster, more efficiently.

In these times of change, the economics of drilling and blasting have changed also. Looking for ways to reduce blasting costs alone is not enough. The real savings come when you look at explosives energy as a way to reduce overall operating costs.

For a closer look at some of the ways explosives energy can lower your costs, investigate Atlas' full line—the only full line of ammonium nitrate and explosives in the industry. Expanded plant facilities are now in production at Joplin, Mo. and Reynolds, Pa., to assure ready availability of all products. And to give you faster, more flexible local service, expanded distribution facilities are being established coast to coast.

Call in your Atlas Representative. His experience with the newest advances in explosives, blasting agents, and blasting techniques can help you measure the relative economy of explosives energy vs. mechanical energy for your particular operation. Ask him about it. Or write directly to:

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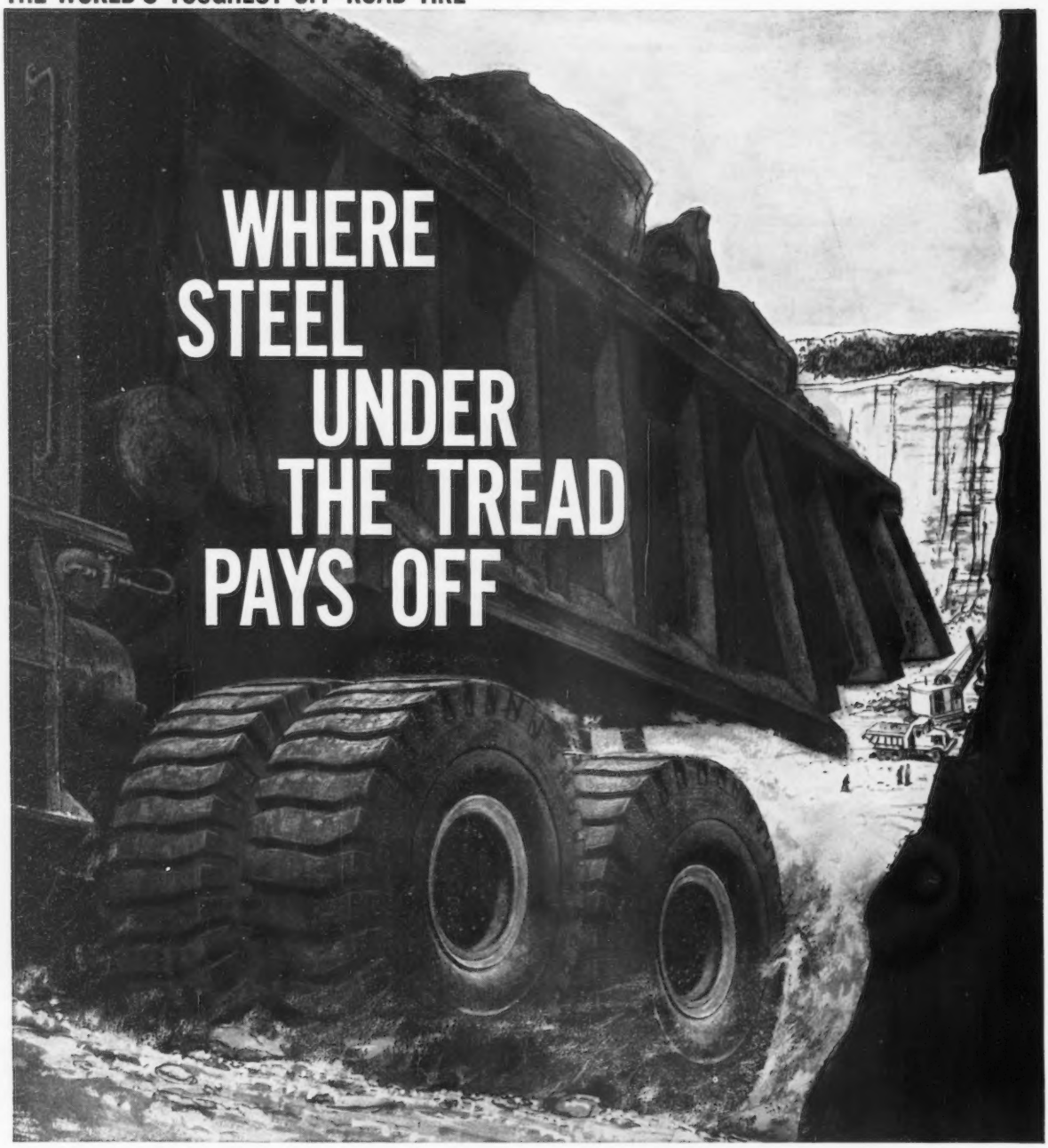

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ENGINEERING AND MINING JOURNAL

The Eighth Annual Guidebook Issue

THE 1961 MINING GUIDEBOOK ISSUE concentrates on costs: of mining, exploration, processing and maintenance. It is introduced by eight pages on mine and plant management, and what management can do to monitor its own costs.

The lead article, and those that follow, contain a great deal of tabular matter. The tables, while numerous, are worthy of careful study. In an industry as complex and individual as mining, it is almost impossible to establish a common basis for cost study. There is no cost-per-ton average which can encompass copper, iron, potash, lead and zinc, nor any other of the vast range of mineral commodities. Neither is there a common denominator for large vs small open pits, hard and soft rock, modern and older underground mines.

It is only possible to cite examples and hope that their cumulative data provide the answer.

E&MJ is extremely grateful to all the mining company executives, operators, equipment manufacturers and industry experts who contributed to the Guidebook Issue.

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What the Mining Industry Can Do About

AL KNOERR

MINING EXECUTIVES and the National Association of Manufacturers are expressing increasing alarm about the "profit squeeze" imposed on industry despite the high-level rate of industrial output. In a 1961 report to stockholders, Robert Koenig, president of the Cerro Corp. expressed concern about the trend in American business toward "profitless prosperity." He said that the long-term trend of narrowing profit margins which started in the middle 50's has occurred during a period of unprecedented industrial activity. Major contributing factors, Koenig said, are beyond the control of individual management. Little can be done about the uninterrupted growth in taxes, he said. "There is a definite limit to the ability to offset higher and higher wages by more and more efficient plant, for the multiplication of capacity tends to defeat its own purpose by the pressure it puts on price."

What Happens to Profits?

In a current industry report, the National Association of Manufacturers notes also that profits have been in a decline. Between 1947 and 1960 the Gross National Product increased from $234-billion to more than $500-billion—more than double. Profits before taxes increased by just about 50%. Profits after taxes increased by a little more than 25%. Thus profits have fallen far behind the growth of the economy. Profits after taxes fell from 7.8% of GNP in 1947 to 4.6% in 1960.

Why Emphasize Costs Now?

Despite general conclusion that the two largest contributors to "profitless prosperity"—taxes and government-supported monopolistic labor—are beyond management control, attention to mining costs by the mining industry will have a direct effect on remedying "profitless prosperity." That is why this Guidebook issue is devoted entirely to mining industry costs, and how to cut them.

Basis of Indexes on Chart

1. The E. H. Boeckh & Associates index is determined from actual residential building costs in 30 cities. It includes skilled and common wage rates and material prices as paid by contractors.

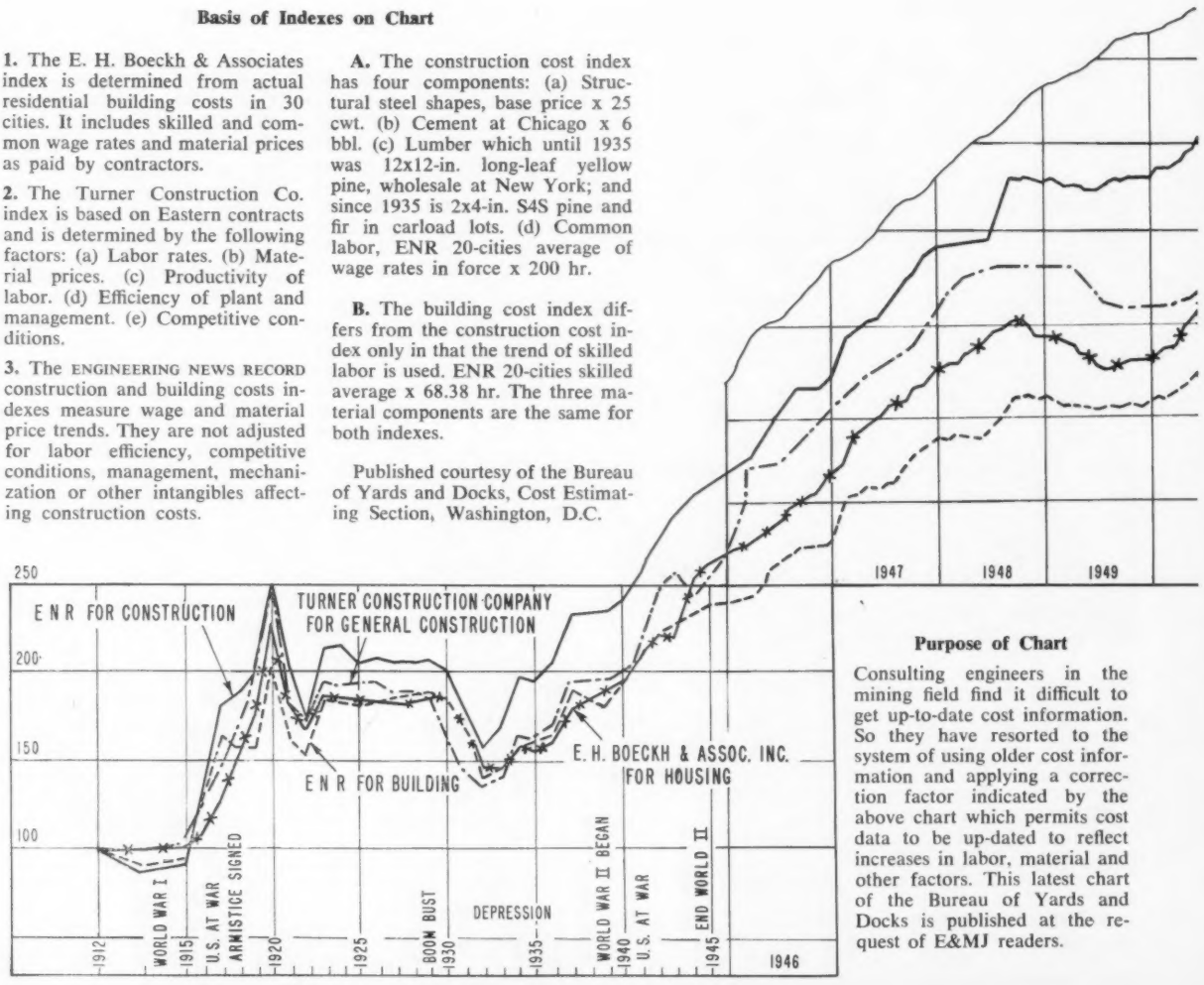
2. The Turner Construction Co. index is based on Eastern contracts and is determined by the following factors: (a) Labor rates. (b) Material prices. (c) Productivity of labor. (d) Efficiency of plant and management. (e) Competitive conditions.

3. The ENGINEERING NEWS RECORD construction and building costs indexes measure wage and material price trends. They are not adjusted for labor efficiency, competitive conditions, management, mechanization or other intangibles affecting construction costs.

A. The construction cost index has four components: (a) Structural steel shapes, base price x 25 cwt. (b) Cement at Chicago x 6 bbl. (c) Lumber which until 1935 was 12x12-in. long-leaf yellow pine, wholesale at New York; and since 1935 is 2x4-in. S4S pine and fir in carload lots. (d) Common labor, ENR 20-cities average of wage rates in force x 200 hr.

B. The building cost index differs from the construction cost index only in that the trend of skilled labor is used. ENR 20-cities skilled average x 68.38 hr. The three material components are the same for both indexes.

Published courtesy of the Bureau of Yards and Docks, Cost Estimating Section, Washington, D.C.



Purpose of Chart

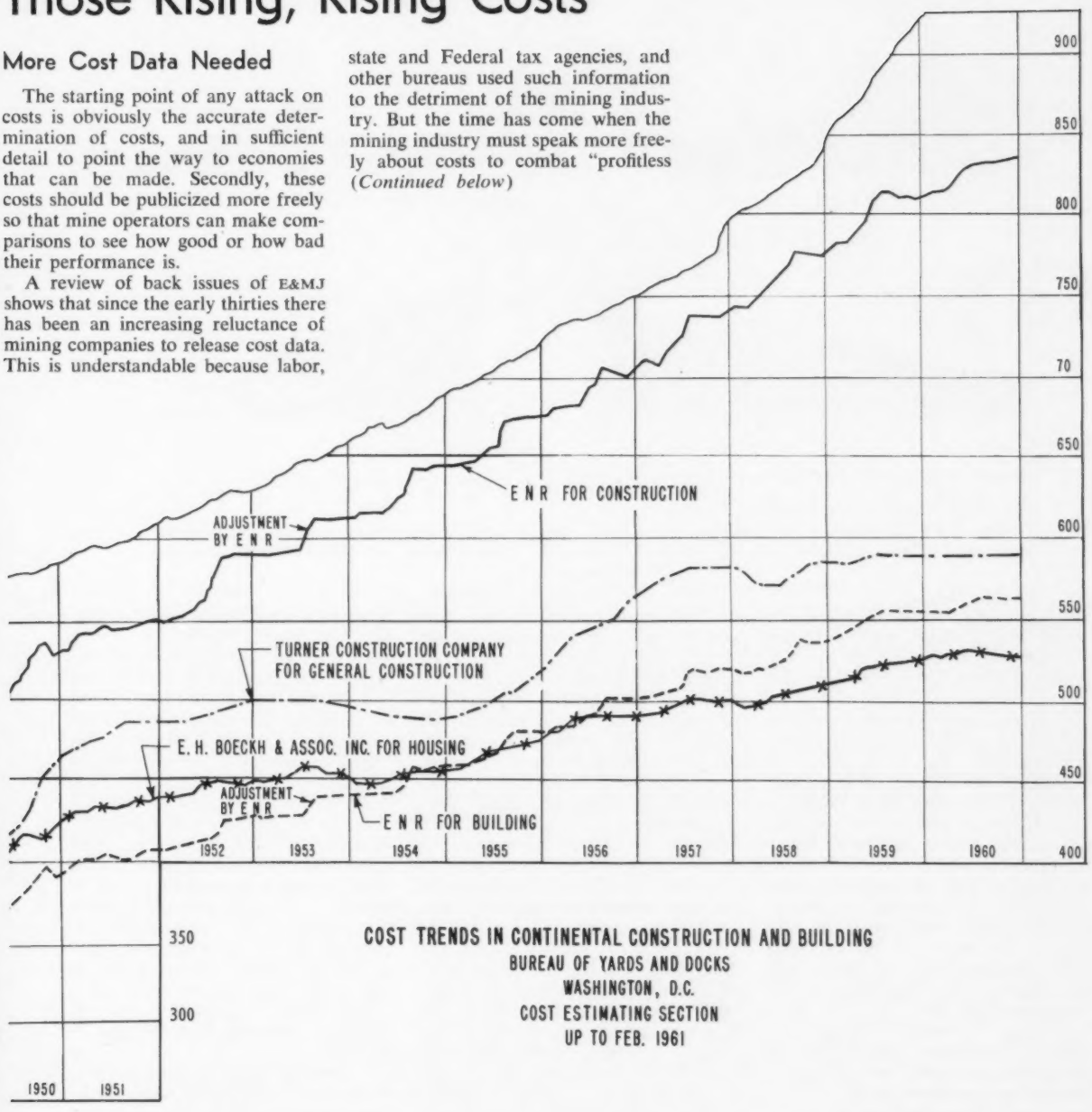
Consulting engineers in the mining field find it difficult to get up-to-date cost information. So they have resorted to the system of using older cost information and applying a correction factor indicated by the above chart which permits cost data to be up-dated to reflect increases in labor, material and other factors. This latest chart of the Bureau of Yards and Docks is published at the request of E&MJ readers.

Those Rising, Rising Costs

More Cost Data Needed

The starting point of any attack on costs is obviously the accurate determination of costs, and in sufficient detail to point the way to economies that can be made. Secondly, these costs should be publicized more freely so that mine operators can make comparisons to see how good or how bad their performance is.

A review of back issues of E&MJ shows that since the early thirties there has been an increasing reluctance of mining companies to release cost data. This is understandable because labor, state and Federal tax agencies, and other bureaus used such information to the detriment of the mining industry. But the time has come when the mining industry must speak more freely about costs to combat "profitless (*Continued below*)



COST TRENDS IN CONTINENTAL CONSTRUCTION AND BUILDING
BUREAU OF YARDS AND DOCKS
WASHINGTON, D.C.
COST ESTIMATING SECTION
UP TO FEB. 1961

prosperity." Let's take taxes and labor costs as examples.

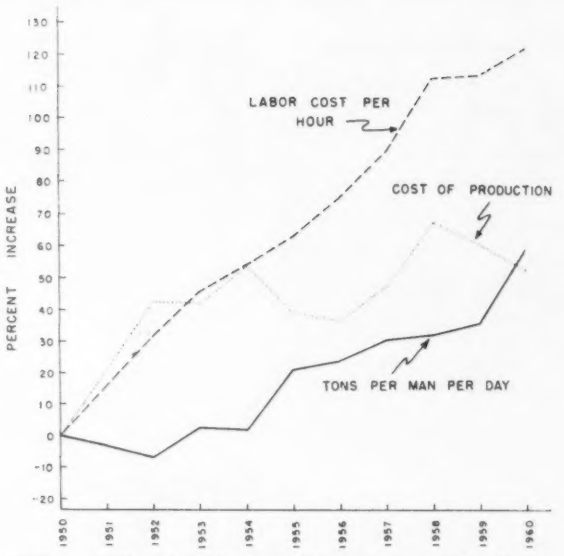
Tax Reforms

If we are going to ask for more liberal depreciation allowances on the grounds that plant costs are rising rapidly because of inflation, somewhere we are going to have to show how much the costs of mines, mill and smelters have increased in the last 10 or 20 years. Attempts to obtain such information from mining companies and engineering and design firms building plants for the mining industry were unsuccessful.

Labor Reforms

If we are going to convince labor that the time has come when it must stop its perennial push for higher wages because such action is pricing both labor and operators out of business, we are going to have to publish more labor costs frequently and pointedly. Note for instance, how effective the labor cost charts compiled by Iron Country operators on p. 184 are in showing that iron-ore miners cannot continue to ask for annual wage boosts simply because the Steelworkers break the line. Already shut-downs reported in E&MJ news columns each month are reaching serious proportions. Nearly all steel manufacturers are agreed that tariffs cannot remedy the situation. They argue that tariffs will only increase the price of steel and discourage consumption. Equally important, the U.S. steel industry says that it must face up to the fact that economic foreign production of steel is whacking away with a two-edged sword—one aimed at invading the U.S market with imports, and the other aimed at our export markets which are declining on the basis of percentage of world markets served by the U.S.

HOW LABOR and production costs have increased at Michigan underground iron mines during the last decade.[1]



HOW LABOR and production costs have increased at Minnesota open-pit iron mines during the last decade.[1]

industry. Even though Western Europe's steel capacity is only 118-million tpy compared with U.S. total capacity of about 150-million tons, Europe's output last year was about 118-million tons. This was equal to the best year the U.S. steel industry has ever had.

One of the fallacies of bargaining tactics of American labor unions is their failure to recognize a basic law of mineral economics: Even though all production of a particular metal, say copper, sells at nearly the same price in world markets, the cost of production for copper may range from 12c to 15c per lb to 30c or more. This completely rules out the concept of industry-wide bargaining in the nonferrous metals mining industry, and failure by the unions to recognize the foregoing has forced mines and miners out of operation simply because they cannot compete with low-cost imports even though they are needed in part to support the metal requirements of the economy. Now if it would be possible to report for the record what it costs to produce a pound of metal at various mining operations, efforts to persuade labor unions to drop outmoded economic concepts might meet with more success.

Good Public Relations

It's good public relations to speak frankly about costs. Note the trend in many annual reports showing in pie charts how the corporation sales dollar is broken up into taxes, labor costs, supply costs, depreciation, etc. with a thin sliver for profits to the stockholder. As another example, we cite the fact that perhaps 90% or more of the American public is under the impression that South American miners are working for peon's wages. Arguments at tariff hearings and occasional letters to the editor from readers objecting to imports of metals bear this out. Now consider how effective the following quotation is in dispelling this illusion: "Despite what you have heard to the contrary, Anaconda's employees and workers in Chile received in salaries and benefits the equivalent of $18 to $25 per day." This comment was taken from a published address made before Sigma Xi, Honorary Scientific Fraternity at Columbia University. Another cost item that might be emphasized publicly and frequently is the amount of money investors have to put up to keep a single man employed at a mining project. The Reserve Mining Co. article, E&MJ, December 1956, reported that cost of the project was $190-million and that the number of men employed at Silver Bay and Babbitt, Minnesota, totaled about 2200. This represents an investment of about $86,000 to create a single job opportunity.

The foregoing are only a few of the collateral benefits that can be attained through the freer exchange of cost data. Actually placing a price tag on every detailed labor operation, and on every piece of equipment and supplies can provide the base for an evaluation program that can cut costs immediately. The three steps involved in cutting costs are:

1. Find out what it costs.
2. Find out why it costs what it does.
3. Develop a staff of cost-conscious engineers and supervisors who will regard cost-cutting as an important and never ending responsibility.

Share Cost Information

"The iron industry in Minnesota, through media such as the Drilling and Blasting Committee, hopes to assure its future in the highly competitive business of producing at a profit. Success depends upon the efforts of individual mine operators, each willing to exchange information with the other to constantly seek and achieve progress in new and better techniques."

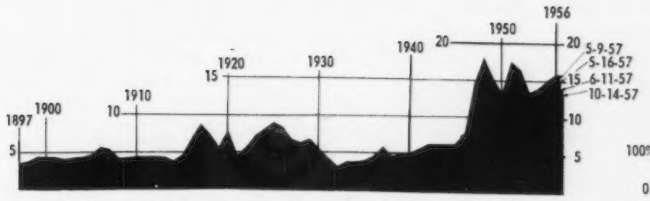
Drilling and Blasting Symposium, Colorado School of Mines Quarterly, January 1959

The Key Management Concepts

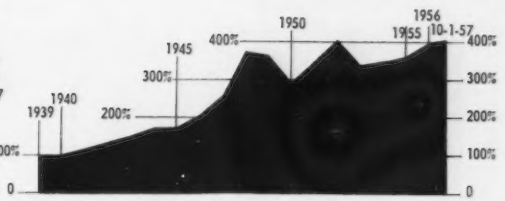
Although the success of cost cutting or control depends upon cost-consciousness and cooperation from the ranks of labor right through to engineering and supervisory levels, the coordination and direction of efforts depend heavily upon management concepts. Casual talks with operating executives since World War II indicate that management philosophy concerning costs is evolving rapidly into concepts which are paying hand-

[1] Source: Twenty Second Annual Mining Symposium, AIME, University of Minnesota, 1961.

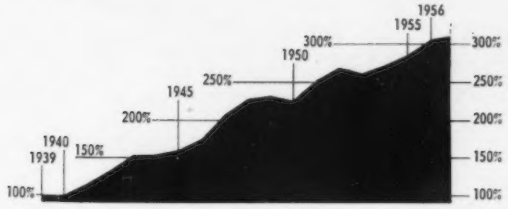
Cost Cutting Pressures



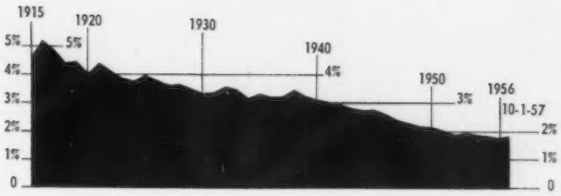
Price of Lead (Cents per Pound—N.Y., E&MJ)



Cost of Producing Pig Lead



Wage Earnings per 8-Hour Shift Worked (1939=100%)



Per Cent Lead in Ore Mined in Lead Belt, S.E. Missouri

A Study in Costs—Southeastern Missouri Lead Mines

THE CHARTS ABOVE were used to supplement statements of Andrew Fletcher, formerly president, now chairman of the board, St. Joseph Lead Co., in hearings before the United States Tariff Commission, November 1947. They illustrate the importance of getting costs on the record in hearings scheduled to air domestic mining problems and initiate policies or legislation to promote a more favorable climate for nonferrous metal producers.

In addition, these charts constitute a profile of the problems that confront mine management—a profile of the pressures on management to maintain economic production in an environment of rising labor costs, rising production costs but declining ore grades, and declining metal prices. (The current price of lead, New York, is 11¢ per lb.)

Just as clearly, these charts show that the only road open to continued economic production is the adoption of modern technology and equipment which increase productivity in the mine and efficiency of extraction in the mill.

Reference to the article, "Viburnum Project Starts Production," E&MJ, January 1961, shows that St. Joe has taken that open road. Incorporated in the Viburnum project are highly efficient drilling, loading and haulage units balanced and cycled to give a high ton-per-man production; and automatic controls, unique materials-handling systems and concentrating equipment designed to yield high recoveries at low cost in the mill.

---

some dividends. The following case histories outline unique approaches to cost cutting:

1. The Over-All Concept. In one Western operation involving underground mining, milling and smelting, the division manager observed that too often mine, mill and smelter superintendents are so engrossed in their own operating costs that they may fail to see that certain savings achieved in a unit operation may be more than offset by increased costs impressed upon another unit as a result. For instance, he noted, the mine operator might be inclined to consign a certain hard, high-silica, low-grade ore to the gob as fill, while at the same time the smelter might be paying premiums to custom shippers to obtain the same kind of fluxing material to improve furnace operation. Similarly the millman might shave costs to produce a certain grade of concentrate which might run up fuel and smelting costs in the smelter.

How Times Have Changed!

"Average mill tailing from a Tri-State ore should not contain more than 2% blende, whereas the average in the past has been nearly 3.5%. On the basis of the total production of the district the loss of 1% blende is equivalent to a loss of $5-million annually."

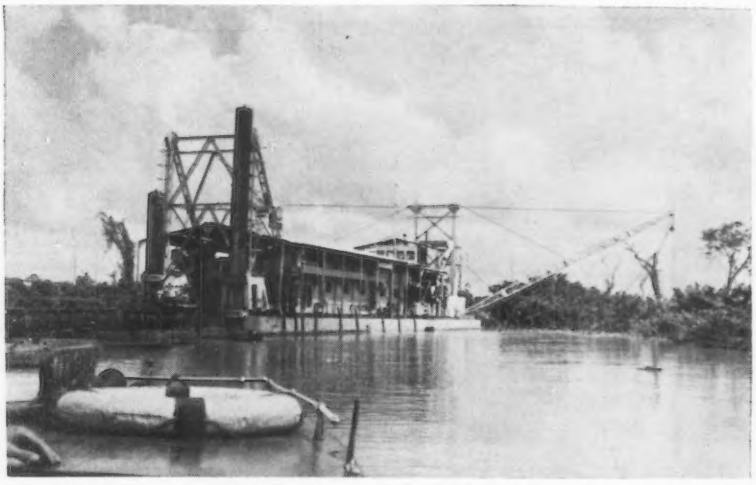
Quote from U.S. Bureau of Mines Report in E&MJ, January 1926.

Note in the above charts that the heads in some Missouri mines today are lower than the tailings of previous operations.

Obviously, the manager concluded, the responsibility of coordinating economy efforts to make sure that they didn't have a negative effect on the over-all operation was his responsibility. He achieved this objective by holding staff meetings at which the mine, mill and smelter superintendents worked out optimum grades and qualities of products for the over-all operations and still maintained cost-cutting targets within the unit operations.

A detail in the flowsheet of the Toquepala mill in Peru, E&MJ April 1960, pp 102-103, shows how the contents of mill concentrate can be adjusted to yield effective metallurgy in the smelter. As in most mills, the aim is to produce the highest grade concentrate without losing excessive values in the tailing. However, because of the fluxing value of mill tailings, the flowsheet provides a by-pass in the tailing line which permits minor amounts of tailing to rejoin concentrates ahead of filtering through a flux take-off valve. Thus the delicate balance of ingredients which the smelter operator needs to obtain good copper recovery is maintained through coordination of the activities of the smelter and the mill.

Case 2. Determine What You're Really Trying to Do. Attention to detail or unit costs without regard to



VERSATILITY and a willingness to try new methods can contribute to economies in mining. In one property of Alcoa in Surinam (Suralco) the above dredge and pipeline system is employed to mine bauxite. In a neighboring operation the company uses trucks and shovels. And yet in the same area, the Billeton operations employ a monitor and pumping system to remove overburden, and a digging wheel and belt conveyor to mine in another deposit.

ultimate objectives can often be self-defeating. To illustrate, in one small western gold mine, the operator was using a small compressed air locomotive to haul four-ore-car trains on a sub-level. Prompted by the common misconception that compressed air is an expensive form of power, we asked the operator, "Isn't that an expensive way to haul ore?" In answer, he clamped a compressed air hose to the empty locomotive tank, opened the valve, filled the tank and detached the compressed air hose all in less than a minute, and said "Now what do you care how much that shot of compressed air costs—with drills running on it by the hour all over the mine?" That 20-second shot of compressed air enabled a single man to do the work of four hand trammers. The lesson was most forcefully taught—"You're not buying compressed air, you're trying to move muck; and with mine labor at $18 per day, the cost of compressed doesn't even come into the picture!"

When Charlie Steen first started the Moab Drilling Co., in Utah, which contracted to do exploration drilling, he said "You don't buy footage, you buy information," which meant that the cost per foot drilled was secondary to the amount of information obtained through maximum core recovery.

Case 3. Blasting vs Comminution. Both the mine and the mill have a common objective—to fracture rock. The question now being studied by industrial engineers and drill and explosives manufacturers is: Which can do the job more effectively and economically? Naturally this requires a fresh look at such unit costs as drilling, blasting, loading, and hauling in comparison with crushing, grinding, screening and conveying costs. It is entirely possible that it will pay some mines, particularly those with hard rock, to spend more money and effort in drilling and blasting to achieve fragmentation that will make substantial savings in loading, hauling, crushing and grinding.

The idea was first suggested in early reports on milli-second delays which noted the following side-advantage to the new blasting technique: "Most startling observation made thus far is that split-second blasting appears to set up incipient strains in blasted rock which make it easier to crush. Consistent results of this nature may mean that the through-put of a crushing plant can be increased considerably during a given period of time." E&MJ, July 1951, p 111.

Subsequently Fred Bond of Allis-Chalmers Mfg. Co. studied the comparative efficiencies of blasting vs crushers in the fragmentation of rock. "Which is the More Efficient — the Crusher? — or Explosives?" E&MJ, January 1954, p 82. With limited data on the energy of explosives but considerable experience in the evaluation of energy required for crushing taconite, Bond concluded, "Considerable plant and laboratory crushing data on taconite for this district are available, which show an average work index of 16.0. However this crushing work index represents kwh/-ton motor input; when the motor and bearing friction losses are subtracted, the work actually applied to the work in crushing is approximately equal to that applied in blasting when breaking to the same size. In other words the mechanical efficiencies of breaking by crushing and by blasting are approximately equal."

Because of great progress in drilling methods and equipment, and new low-cost explosives, an opportunity exists for explosives manufacturers, drilling equipment manufacturers and mine industrial engineers to pursue the crusher vs blasting study more thoroughly. The following information is needed: (1) Detailed costs in cents per ton for drilling, blasting, loading, hauling, conveying, crushing, screening, and grinding. A comparison of magnitudes will show at a glance whether it will pay to spend more money breaking rock in the mine to save more money on the wear and tear of loading and hauling equipment and in the mill. (2) The amount of energy locked up in a pound of explosives, expressed in foot-tons or kwh. (3) The true efficiency of explosives in fragmentation and throwing rock. (4) Methods to harness the power of explosives more efficiently. (5) The cost of explosives in terms of kwh per lb.

If better fragmentation can be produced by pit blasting, it would also be necessary to determine how much money is saved through increased tonnage per truck-shift or per shovel shift. Similarly, repair and replacement costs for dipper teeth, dipper sticks and shovel cables would be cut appreciably.

Efforts to obtain supporting cost figures for this contention for this guidebook issue have been unsuccessful. However, enough cost data have

Keep Equipment Busy

"The more the equipment costs, the more you have to keep it busy. In an open-pit mine the shovel which costs several hundred thousand should never wait on the truck."

Open-Pit Operator

"It's down-time that kills the little operator. If we could only put a taxi meter on equipment that would tick off the costs as the down-time minutes go by, perhaps we could really cut operating costs."

Equipment Engineer

been compiled to indicate that further study of this cost-cutting objective will be profitable for mine, explosives and equipment manufacturers.

Case 4. What Constitutes an Operating Unit? In early studies of small mine operations on the Colorado Plateau, it was suggested that if numerous properties would combine and operate as widely separated stopes of a common mine, rather than as individual properties, they could get along with lower capital investments in equipment that could be shared, and that management and overhead costs could be slashed. To a limited extent, small mines in Idaho and Colorado have joined to form consolidated operations, or groups of small operations have been purchased by a central company which was able to continue production profitably during periods when operation by individual owners would have been uneconomic.

Some mining theorists have suggested that large mining companies with division operations in several states could obtain greater economies by programming production and operation of all major units as part of a large mining entity, adjusting production in high-cost and low-cost orebodies in accordance with shifts in the selling prices of metals. It is proposed that now that computers can handle fantastic volumes of calculations, it is possible to operate the various units at varying rates theoretically and compute the resulting costs and yields to determine optimum operating rates for changing grades, changing metal prices and changing costs.

Case 5. The Object of an Accounting System. Cost-conscious management says that there are two objectives of a mine accounting system: (1) To put the finger on costs, and (2) To point the way toward cutting them. In open-pit mining using trucks for haulage, the most important cost item is tires. Tire wear accounts for 30- to 35% of haulage costs. Consequently, cost records on tires should be kept in detail, even to the point of tracing the performance of tire wear by brand and serial number. In one Western operation tire records are used to determine which brand should be purchased. By pursuing this policy the company has induced tire manufacturers to improve the quality of their products, and has placed its orders with the company producing the best-performing tires. By actual test no one manufacturer has captured the company's business exclusively because the competitive struggle between tire manufacturers has shifted the most-favored position from one brand to another several times in the past 10 years.

Cost-Conscious Engineers

"Check any of the following qualifications which are necessary for a good engineer," Out of 158 replies, these ranked highest:

Resourcefulness	*146*
Cost consciousness	*140*
Ability to write	*133*

From a survey on mining education sent to more than 200 top executives and operators in the mining industry.

Industrial Engineering

During the past 10 years the concept of applying industrial engineering to mining has gained increasing acceptance. Although not labeled by that name, first applications appeared in the form of articles on quality control in mills. International Minerals & Chemical Corp., now headed by Tom Ware, an industrial engineer, has been a pioneer in the application of industrial engineering concepts to mining and mineral processing. Ware's classic article, "Operations Research and the Mine of Tomorrow," E&MJ, August 1955, shows how management can apply logic and scientific analysis to solve such practical problems as determining optimum mine-plant operations, or how to run a million-dollar dragline on a computing machine to ascertain most effective operations in the pit.

Subsequently, mining literature has carried articles and news on industrial engineering at Kennecott's operations at Anaconda, in the Carlsbad, N.M., area, at Bunker Hill, in Canada and South Africa.

Cost Cutting, an Objective

One of the major targets of an industrial engineering program is to cut costs. B. Blain Bradford, industrial engineer of Kennecott Copper Corp., showed how I.E. had saved in excess of $1.5-million at the Utah Copper Division in his article "How Industrial Engineering Cuts Costs at Kennecott," E&MJ, May 1961. Functions of Kennecott's industrial engineering department, which was started in 1954, include developing and installing modern wage and salary procedures, production control procedures, methods improvement, and maintenance schedule programs.

Study Cost Trends

"Current costs are not enough to help you decide which type of equipment you should use. You have to study cost trends. A certain type of equipment may be more economic to use today. But if that item has a fast rising cost history, it may price itself out of the market five years from now."

Mine Operator

Bradford said three misconceptions pertaining to I.E. created a real obstacle to getting the program started. These were:

1. The techniques and tools of industrial engineering could only be applied profitably to repetitive manufacturing industries.

2. While industrial engineering might create modest savings in operations, significant over-all improvements could be obtained only through installation of new equipment and facilities, the discovery of new orebodies, or the development of entirely new processing technologies.

3. Industrial engineering would create an unnecessary "staff empire" that would invade the functional areas of supervision, engineering, industrial relations, accounting, etc., and lead to friction and duplication of effort.

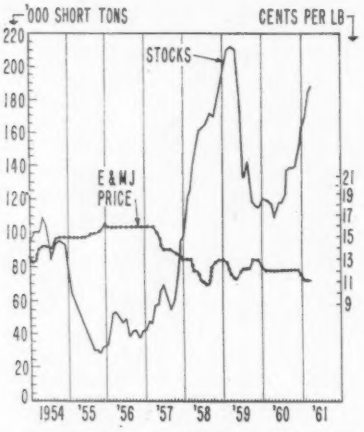
Actually, mining engineers have been practicing industrial engineering ever since they made their first time studies in the mine (work simplification), or checked pulp densities and tailings assays in the mill (quality control). So there should be no reluctance to adopt principles of industrial engineering even if an operation is not large enough to support an industrial engineering department. Mining educators are incorporating more industrial engineering concepts in their curricula each year.

An industrial engineering handbook[1] would be a good investment for any mine library. Here are some functions covered in an industrial engineering handbook which were checked off by a professional industrial engineer as being particularly applicable to mining:

Methods
- Operation analysis and improvement
- Work simplification
- Materials handling
- Technological intelligence
- Production planning
- Clerical procedures
- Safety
- Communication systems
- Standardization

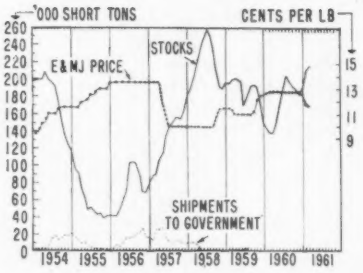
[1] Industrial Engineering Handbook. H. B. Maynard, Editor-in-chief. McGraw-Hill Book Co. New York 36, N.Y. 1956

Primary Refined Lead Data



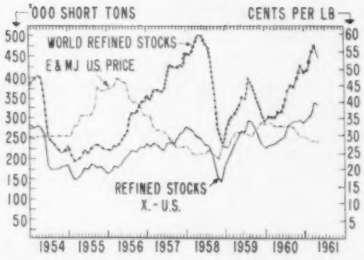
The above data, in thousands of short tons, are from the American Bureau of Metal Statistics. They refer to the total amounts of refined lead as reported by all primary refiners in the U.S. Some secondary lead is included. "Shipments to industry" includes exports. Data are through March.

U.S. Slab Zinc



The above data, except price, are from the American Zinc Institute and are in thousands of short tons. They refer to slab zinc of all regularly operating United States primary and secondary smelters. Data include February.

Copper Production and Stocks



Data, except price, are from the Copper Institute and are in thousands of short tons. They include March 1961. World refined output and stocks do not include the U.S.S.R., Japan, the Scandinavian countries, Yugoslavia, and the Mesina Mine in Transvaal. The series "X-U.S." are the above world stock statistics less the U.S. No fabricator stocks are included. Beginning with Jan. 1960 the C. I. includes data for mines formerly excluded.

Price vs Production

THESE CHARTS show how overproduction of metal as indicated by accumulating metal stocks influences prices. When stocks go up prices go down, and conversely when stocks go down, prices go up. Cost-cutting can be nullified by poor marketing policies of the nonferrous metals industry.

Work measurement
- Labor performance
- Cost performance
- Production performance

Wage payment
- Wage incentives
- Job evaluation
- Merit rating
- Wage and salary administration

Controls
- Production control
- Inventory control
- Quality control
- Budgetary and cost control
- Management controls

Plant facilities and design
- Plant layouts
- Equipment procurement and replacement
- Equipment and tool design

Others
- Suggestion systems
- Operations research
- Preparation of operating and maintenance manuals
- Organization planning

Sources of Cost Information

Mining symposia, now being held with increasing frequency both at home and abroad, are valuable sources of cost and operating data. They have set a pattern somewhat apart from national society or association conventions where conflicting social, political and organization sessions compete for the time and interest of the operator who is primarily interested in talking shop and costs. The mining symposium, if not overly organized or overloaded with papers, is more conducive to the casual exchange of valuable spontaneous operating information than a program conducted under split-second timing and with limited discussion.

The Futility of Cost-Cutting

Mine, mill and smelter operators, beating their brains out to achieve a saving of a fraction of a cent in production costs, have posed this question: What advantage is there to shave costs when the marketing policies of the nonferrous metals producers can wipe out all gains in a day by unsound marketing policies.

The history of marketing policies of nonferrous metals producers is recorded in the graphs and tables on these pages. Note that refined metal stocks are more than a statistic—they are a record of overproduction. The accumulation of excessive metal stocks is evidence that an industry has misjudged its markets; that an industry has placed too much emphasis on production and not enough on sales research and market development for products.

Note how consistently prices go down when stocks (overproduction) go up; and conversely when industry disciplines its productive efforts to conform to market demands, prices increase.

A second lesson on the economics of metal production is illustrated in the table and graph on p. 189. Here we see that the cost of producing a pound of copper is by no means uniform even though industry needs copper from all sources to keep going. Secondly, the tax bite accounts appreciably for the cost of a pound of copper to the consumer, and it is increasing each year. Finally, there is a definite relationship between the price of copper, and the amount of copper that mines of the world can produce economically. Management's responsibility is to gage this relationship and adjust production accordingly.

The complexities of metal marketing are compounded by the capriciousness of labor unions. If dominated by communistic leadership (as in the past), mine labor unions can become political instruments to nullify all the efficiencies and cost-cutting efforts that our well-trained engineers and supervisors can introduce. Collusive strike calling (free from Department of Justice intervention) in Africa, Chile and the U.S. has kited copper prices to unprecedented highs. These price gyrations have seriously jeopor-

Advice From the Top

"The purpose of a company bookkeeping system is not simply to tell how much money you made. It must be set up so that you can keep track of costs in sufficient detail to point the way toward more economical operating methods."

Vice President, mining company

Cost Per Pound—Five Year Moving Averages of Some Leading Copper Producers

(Cents per lb., U.S. equivalent)

		1949–53	1950–54	1951–55	1952–56	1953–57	1954–58	1958 Copper production—Thousand lb
Kennecott	Before taxes	11.103	12.037	13.078	14.475	15.862	16.346	637,464
	After taxes	16.779	18.319	20.685	23.169	24.314	24.216	
Phelps Dodge	Before taxes	12.240	13.460	14.600	15.810	16.230	15.690	437,148
	After taxes	17.140	18.920	21.010	23.020	23.540	22.840	
Greene Cananea	Before taxes	17.659	19.307	21.429	24.824	NA	NA	61,188
	After taxes	19.899	21.674	24.449	27.959	NA	NA	
Andes Copper	Before taxes	19.976	20.975	22.536	23.689	E 24.162	E 23.697	71,962
	After taxes	21.334	22.225	24.763	27.430	E 28.590	E 28.395	
Chile Copper Co.	Before taxes	14.497	15.375	15.969	16.780	E 17.115	E 16.977	469,198
	After taxes	18.737	19.695	21.961	24.134	E 25.154	E 24.983	
Braden	Before taxes	16.315	17.318	18.004	18.885	19.262	19.107	383,156
	After taxes	19.183	20.247	21.933	24.039	25.045	24.874	
Mufulira	Before taxes	12.186	13.198	14.987	17.393	18.773	18.636	199,017
	After taxes	19.141	19.949	22.058	24.518	25.127	24.076	
Average:	Before taxes	14.854	15.953	17.229	18.837	18.567	18.409	
	After taxes	18.888	20.147	22.408	24.894	25.295	24.897	

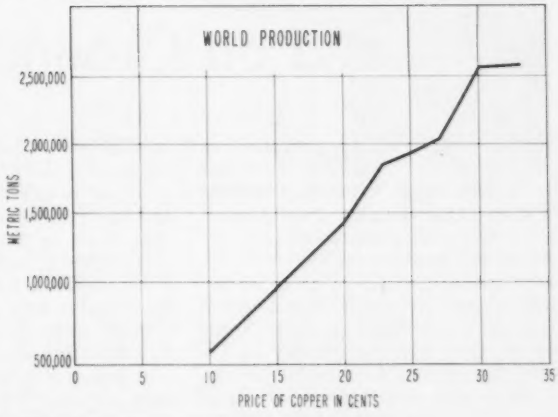
NA—not available
E —estimated

Total, 7 companies 2,259,133
Total World, incl. U. S. S. R. 7,200,000
Percentage of World Total 31.38%

Cost vs Production

Even though all copper sells for about the same price in world metal markets, the cost of production varies from about 15¢ to 30¢ per lb or more. The table (right) shows cost estimates for various periods. Source: "The Price of Copper, 1960-1975," by William Shea, statistician, C. Tennant Sons & Co., E&MJ, August 1959.

The chart on right is based upon a study of operating costs for many of the world's important copper producers. It shows graphically how changing prices in copper can stimulate or retard production. Because of this inter-relation between selling price and production, the responsibility of maintaining production that will maintain orderly markets and stable prices rests with the executives who chart company marketing policies as well as mine output. A surplus of metals can readily tumble prices several cents, and nullify all the efforts of mine, mill and smelter operators to shave a few cents or fractions of a cent through increased efficiency and modernization. Source: "Estimation des Prix de Revient des Principales Mines de Cuivre," A. Stahl, Ingenieur au Corp. des Mines, ANALES DES MINES IV, 1957.



dized the acceptance of copper by industry, and induced a switch to alumium in many products. Perhaps the remedy lies in acquainting labor with its responsible part in the production of metals through a franker discussion of costs and prices and their impact on the jobs that will or will not be available in a particular mining area. We note, for instance, that Kennecott Copper Corp. has demonstrated and publicised the need "Keep Copper Competitive," in its publications to Western employees. Paralleling this campaign, Kennecott has instituted an effective suggestion-award program which has the double advantage of making its workers cost-conscious and partners to management in producing copper at economic levels.

Acknowledgements

The compilation of cost data for this issue has been a most difficult assignment because of the traditional reluctance of mining companies to talk about costs. There are many omissions of data which we had hoped to obtain for industry, but which were simply unavailable. Much of the data was given to us on the condition that none of it should be attributed as to source or even traceable as to source. Accordingly, some credits have been intentionally omitted, and figures revised somewhat to obscure source. Nevertheless, we are deeply indebted to mining companies, manufacturers, the U.S. Bureau of Mines, numerous mining symposia, and contemporary publications for the cost data that are reproduced in this issue. One of the editorial risks involved in the publication of cost data is that certain manufacturers of equipment will claim that such data has placed their products in a disadvantageous position. We have assumed that risk, and have tried to report merely what industry operators think, and not pass judgement on the type of equipment that will do a particular job best.

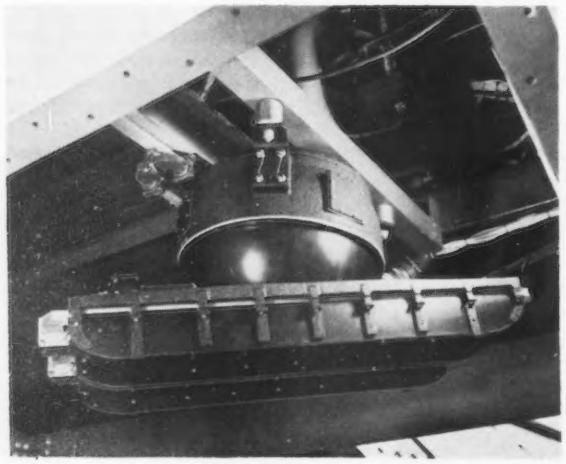
In response to inquiries for cost data, many mining companies replied that they would be willing to give information if they could be assured (1) that it would not be attributed to source, and (2) that other mining companies in industry would also be willing to give out cost information.

SMALLER, lighter craft now carry both electromagnetic detector and magnetometer.

Exploration Costs Reduced In Air and on Ground

SINCE WORLD WAR II, airborne geophysical reconnaissance has accounted for a continually expanding amount of mine exploration surveys for small and medium-sized operations, and for the widely scattered holdings of the international industry giants. In recent years, the aerial survey firms also have received contracts from governments and the various world-wide foundations to quickly yet accurately map out and analyze vast tracts of unexplored land in both hemispheres and in the polar regions. An estimated 5-million line miles of airborne magnetometer projects (oil and mineral surveys) have already been flown in the Free World.

In previous issues, E&MJ has followed those developments; followed the stripping back of South America's interior; reported the problems of individual companies and how air surveys solved them—quicker and with more accuracy than could be possible by any other method.



DOPPLER RADAR guides the survey aircraft over undifferentiated terrain without ground stations—costs far less than Shoran or other systems needing ground stations.

No matter how large or small the project, and regardless of where it is being done, all airborne exploration must be broken down into: 1) flying costs; 2) compilation costs; and 3) interpretation costs.

Flying costs can vary from $2.00 to $6.00 per mile and will depend upon any of the following considerations: mobilization costs; weather; diurnal variations (magnetic storms); navigational equipment; number of personnel; type of aircraft; logistics; and geological considerations.

During projects that are both sponsored and carried out by governments, the problems of logistics are often overlooked. However, when surveying even apparently mild terrain, private surveyors are continually concerned with factors of distance from airstrip to project area, spare parts, customs (when the survey is being carried out overseas), freight rates, permits, laws and regulation. Anyone of these could cause an unusual increase in flying costs.

Next in the three-part analysis of survey costs is compilation. Costs here can vary from $1.00 to $4.00 per mile depending upon what type instruments are used to compile the data and just how accurate an analysis is desired for the project area. Factors here are: scale of maps; density of data; contour interval; magnetic signature; and positional data (flight maps, Shoran or Doppler, etc.)

After flying data has been collected, it must be interpreted. Once again, the cost varies in direct proportion to the amount and depth of analysis. The interpretation portion of the total survey cost will be approximately $1.00 to $3.00 per mile and will be determined by: the amount of data; the complexity of the data; available literature; the amount of ground follow-ups required; and the depth of penetration.

The high and low cost figures for flying, compilation and interpretation should only be used as preliminary estimates — unpredictable developments during a specific project could either greatly reduce or increase these costs. Therefore, and only for guiding purposes, total costs could be as low as $4.00 and as high as $13.00 per line mile.

The following case histories, supplied by Aero Service Corp., indicate the kind of operations now being done for governments, large companies, and small, limited-budget operations.

Case 1—Government survey, Venezuela. Survey area about 35,000 sq miles. Cost is based on a monthly fee for aircraft and crew, plus a rate per line mile flown, producing a price between $9.00 and $11.00 depending

on production achieved. Survey includes magnetometer, scintillation counter, and Doppler radar, and the map scale is 1:40,000; 20 gamma contours.

Survey is done in dry season over rain forest and the mineralized areas are Precambrian. Flight altitude is 500 ft.

Case 2—Government survey, Surinam. Here is a 68,000 sq mile survey which is Doppler guided over a rain forest. Cost is approximately $10.00 per mile, including interpretation. Instruments include magnetometer and scintillation counter and the scale is 1:40,000. The aircraft is a DC-3 and the survey crew includes two pilots, two electronics engineers, one mechanic, one geophysicist, and two data compilers.

Case 3—Andean survey for large mining company. Here the cost is about $10.00 per mile (including interpretation) for a 20,000-mile project over mountainous terrain. Only a magnetometer is involved and the crew includes a pilot, an electronic engineer, a mechanic, a data compiler and a geophysicist.

Case 4—Small detailed magnetic survey. This survey is in "cultured" area near airports. The map scale is 1:20,000 and the contour interval is 50 gamma. Flight altitude is lower, with closer line spacing (⅛ mile rather than ½ or ¼). The crew is a pilot with one or two men and all data is compiled at Aero Service in Philadelphia. The cost is about $2,500-$3,000 for about 120 miles.

Case 5—Reconnaissance Magnetic survey. This is a survey of some aerial extent (10,000 miles or more) with a one or two man crew. Flight line spacing is about one mile with a 500-ft flight altitude. No compilation except over selected areas, and the cost, without compilation, is under $5.00 per mile. This is a limited-budget survey to map out good areas which may later be pin-pointed.

Case 6—In-Phase electromagnetic survey. Here the project is within 300 miles of an airport and covers an area of about 3,000-4,000 miles. Equipment includes a high sensitivity in-and-out-of-phase EM detector, with Gulf magnetometer and scintillation counter. The aircraft is a DeHavilland Otter or Canso (PBY) amphibian and the flight spacing is ⅛ mile. This survey costs about $17.00 per mile and the compilation is a map of the area rather than a contoured map. Selected anomolies are diagnosed and portrayed.

Just how airborne geophysical exploration has progressed since first being applied to mining, and what may be the developments in the next few years, can be shown in the following trends.

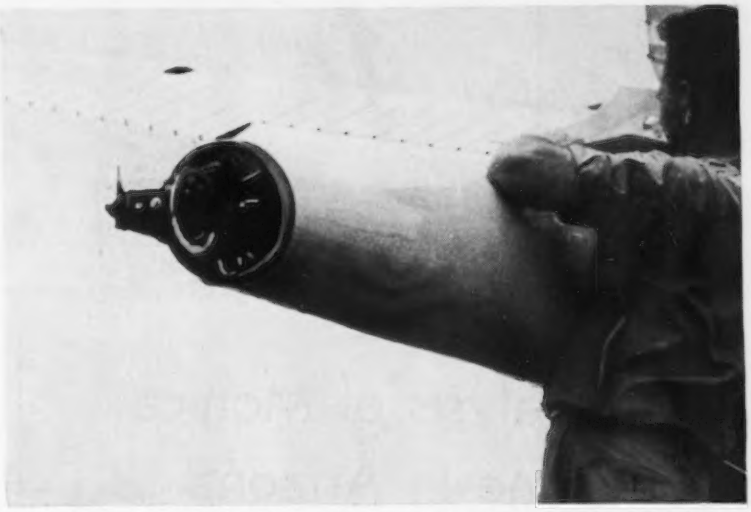
1) Costs have been steadily dipping and are now down about 35% since 1955.

2) Despite the lowered costs, survey quality has increased—resulting from the more than 2.5-million miles of mineral surveys.

3) Governments are calling for more reconnaissance surveys while mining companies are contracting for detailed surveys. Canada has negotiated a 12-year, $18-million survey for the mapping of much of its northern territory; Washington, Wisconsin, and Missouri will now be surveyed; and under-developed nations in Africa and South America will be undertaking more UN- or ICA-sponsored surveys.

4) Many equipment improvements, including: Doppler guidance over undifferentiated terrain (Surinam and Venezuela); inboard magnetometer installation (tail or wing) to permit lower altitude surveys, and surveys in rougher weather, with truer record; and lighter or more efficient aircraft to carry survey equipment and reduce flying costs.

AMONG other gear, amphibian Canso carries in-phase EM system and Doppler radar.



AIRBORNE magnetometer installed in tail gives truer record than trailing bird.

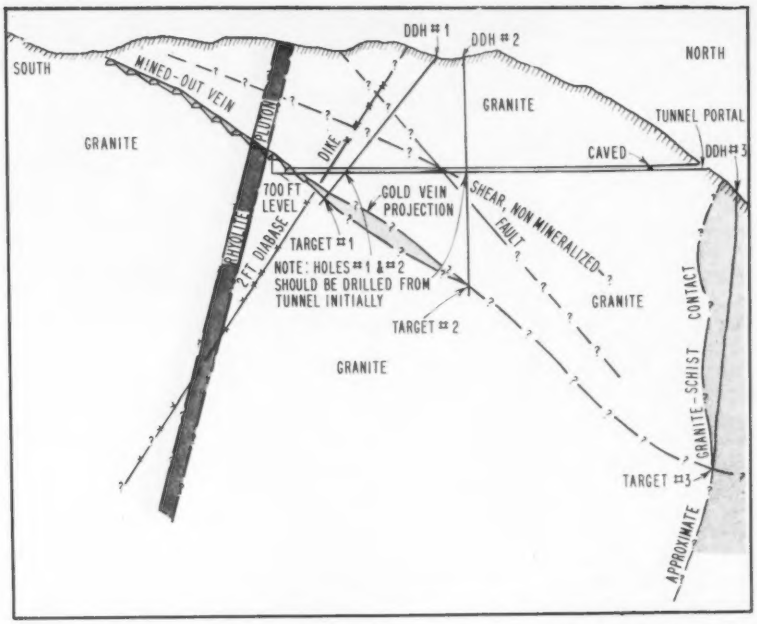
5) The survey firms are doing more packaging. Not only are they flying an area—gathering information and then corrolating it—but are also supplying geological, equipment, and mining advice, and contracting for the actual development of the mining property they have surveyed.

An example of the package program was the three-part exploration-through-center line survey that was done recently by one survey firm for Quebec Cartier Mining Co.

The first part of the program, exploration, included photo-geology, then aerial magnetometer or electromagnetometer surveys to aid the geologic evaluation—then ground follow-up.

Quebec Cartier reconnaissance included: photos; photo-mosaics; photo interpretation studies; forecast access roads; aid in location of plant site, town sites, power facility, and harbor development.

Program's final development involved detailed road maps prepared from aerial photos—material to be moved was measured by cross-sections plotted from the aerial photos and then the survey company ground crews staked center lines.



DIAGRAMMATIC CROSS-SECTION of the ore zone, which is based on Mr. Patchick's field notes, outlines the exploration goals (targets 1, 2 and 3)

Cost Analysis of Monica Gold Mine in Arizona

MR. PATCHICK is consultant on mining to Geodynamics Inc., Santa Monica, Calif.

PAUL F. PATCHICK

Mr. Patchick is an economic geologist who, for the past eight years, has evaluated mines in Korea, Japan, Mexico, Jamaica, and the United States. It is his contention that it is not sufficient to publish evaluation reports for only those properties that seem favorable; that much useful data and ideas may be obtained from the reports of locations that do not eventually become producing areas and that these reports might conceivably help to cut exploration costs at future projects that may have some of the problems and similarities of the Arizona gold mine discussed in the following pages.

Thirty three years ago in E&MJ, Mr. Ira Joralomen discussed the concept of the "Weakest Link". (March 31, 1928. "The Weakest Link: Or Saving Time in a Mine Examination"). He explained that a successful mine is dependent on a whole "chain" of favorable conditions, and, if a single "link" is too weak, the strength of the other links is immaterial. To cite an example: if a potash deposit in Ethiopia is 90 miles by dirt road from a prospective shipping point, it is unimportant whether or not the average grade is 18% or 20% K_2O, or whether ore "in sight" consists of 50,000 or 100,000 tons. What is important, however, is whether or not an enormous deposit can be developed which will pay for a railroad to the property and port facilities on the seacoast. Detailed sampling and reserve calculations are unnecessary if a cursory examination of geology combined with a few test pits or drill holes shows that no huge, minable reserve is present. In view of appreciable transportation problems, then, limited tonnage of ore is sufficient reason for turning down a prospect.

Three types of problems are presented to the examining geologist or engineer:

1 Exploitation prospects. No question as to ore quantity; ask: "What is average grade?" and "Can it be treated at a profit?"

2 Extension prospects. Have some ore of good grade; ask: "Is there any more ore?"

3 Exploration prospects. Geology favorable and encouraging; Ask: "Is there ore?" and if so, "Where?"

This article will use the Monica gold mine case history as a current example of the "Weakest Link" concept. Here, the weakest link proved to be first, grade of ore, and second, reserve tonnage. How one week of examination was conducted, will be discussed step-by-step.

The Monica is in fairly steep topography at an elevation of 4600 ft in the Weaver mining district, approximately four miles by dirt road from Yarnell, near Kirkland Valley, Yavapai County, Arizona. There is no surface water in the immediate vicinity of the mine, although a small amount issues from shears and fractures and flows out the main tunnel entrance. The nearest power lines are about 1¼ miles away.

Structure Is Complex

Steeply dipping Precambrian mica and hornblende schists and gneisses of the Yavapai formation have been intruded by a younger Precambrian alkali granite (probably correlative with the Bradshaw granite to the north). The granite has been fractured and subsequently filled with hydro-

thermal quartz, native gold, argentiferous galena, and auriferous pyrite. A postvein Tertiary rhyolite pluton cuts the orebody in two places underground, and has been observed cropping-out on the surface. The rhyolite is extremely fine-grained, and where penetrated by the main raise, is 55 ft wide, plunging southwest. Another intrusive, in the form of a diabase dike two ft thick, cuts a fault in the lowest workings (700 level) and probably intersects the gold vein at depth.

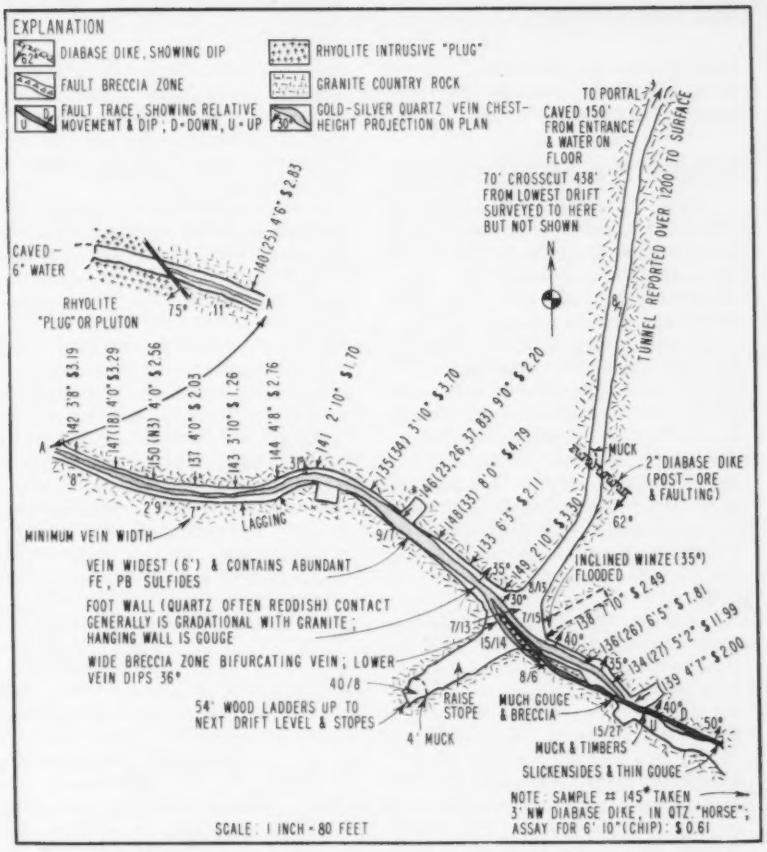
The Gold Vein: The vein is characterized by swelling and pinching, both down dip, as well as laterally along the strike. In every drift examined above the lowest one mapped, the vein pinches-out laterally. At the surface outcrop, the vein is about 2 ft thick. It attains a maximum thickness of 8 ft many hundred feet down dip. Minimum thickness in the lowermost level is seven in.; the maximum, 6 ft. Average thickness is 2½ to 3 ft.

Many footwall bulges were reported by miners to have contained "rich ore" as well as vein material near the hanging wall. In many widely scattered places the quartz vein is sheared in the center, showing much clay gouge and quartz breccia, with the hanging wall "frozen". Thin selvages of gouge are found on both hanging and footwalls. The latter contact is gradational into granite which is typified by abundant orthoclase feldspar masses.

According to miners, as much as 9 gold oz/ton ($315/ton); was reportedly shipped from hanging-wall pockets. Massive white quartz, and contact granite were said to have averaged between $3 and $4 per ton. The mine operated on-and-off from 1902 to 1917, and from 1948 to 1956. An average value of $10 to $15 per ton was claimed over the many years by various owners.

Structure: The gold vein has been emplaced within apparently structureless granite, which has intruded steeply dipping metamorphics. The vein dips between 25-and 40° to the north and northeast. Its dip is least at the outcrop, but becomes increasingly steeper with depth. The vein strikes E-W to N. 45 W., whereas foliation and schistosity in the Yavapai formation generally trend N. 45 E., dipping in a northwesterly direction. Thus there appears to be no structural control related to bedding or schistosity. However, a possible change in vein composition is anticipated upon its reaching the schist-granite contact at depth.

In the southeastern part of the lowest drift on the 700-ft level, the gold vein is faulted. The fault is believed to be normal, i.e. the hanging-wall moved down relative to the footwall, although it is impossible in the present state of development to determine the absolute movement or displacement. The reason why miners continued drifting southeastward along the fault (rather than going down after the offset vein) probably lies in the fact that elsewhere the fault is mineralized, and it was hoped that it would once again become gold bearing. At other places, however,


EXPLANATION
DIABASE DIKE, SHOWING DIP
RHYOLITE INTRUSIVE "PLUG"
FAULT BRECCIA ZONE
GRANITE COUNTRY ROCK
FAULT TRACE, SHOWING RELATIVE MOVEMENT & DIP; D=DOWN, U=UP
GOLD-SILVER QUARTZ VEIN CHEST-HEIGHT PROJECTION ON PLAN
TO PORTAL
CAVED 150' FROM ENTRANCE & WATER ON FLOOR
TUNNEL REPORTED OVER 1200' TO SURFACE
70' CROSSCUT 438' FROM LOWEST DRIFT SURVEYED TO HERE BUT NOT SHOWN
CAVED - 6" WATER
RHYOLITE "PLUG" OR PLUTON
2" DIABASE DIKE (POST-ORE & FAULTING)
MINIMUM VEIN WIDTH
LAGGING
VEIN WIDEST (6') & CONTAINS ABUNDANT FE, PB SULFIDES
FOOT WALL (QUARTZ OFTEN REDDISH) CONTACT GENERALLY IS GRADATIONAL WITH GRANITE; HANGING WALL IS GOUGE
WIDE BRECCIA ZONE BIFURCATING VEIN; LOWER VEIN DIPS 36°
INCLINED WINZE (35°) FLOODED
54' WOOD LADDERS UP TO NEXT DRIFT LEVEL & STOPES
RAISE STOPE
4' MUCK
MUCH GOUGE & BRECCIA
MUCK & TIMBERS
SLICKENSIDES & THIN GOUGE
NOTE: SAMPLE = 145* TAKEN 3' NW DIABASE DIKE, IN QTZ "HORSE"; ASSAY FOR 6' 10" (CHIP): $0.61
SCALE: 1 INCH = 80 FEET

PRICES INDICATE the total value of gold and silver per ton. Sample numbers recorded by the previous engineer in parentheses.

Small Mine Examination Cost (1956) as typified by the Monica gold mine, Arizona

Supervision (by the company Geologist)	
Salary @ $22.50/day x 10 days (7 field, 3 office)	$225.00
Expenses—room and board @ $12/day x 7 days	84.00
Labor	
Geologist's assistant (for mapping and sampling)	
Wages @ $10/day x 7 days	70.00
Expenses @ $12/day x 7 days	84.00
Sampler (used as carpenter also)	
Wages @ $10/day x 4 days	40.00
Supplies	
Lumber and nails	15.00
Canvas, canvas sample bags, wire, wax	38.00
Brush, carbide, singlejacks, moils	18.00
Auto: gas and oil	15.00
Assays	
18 assays (Au and Ag) @ $4.50 ea.	81.00
Approximate total cost of examination	$670.00

$\frac{\$670.00}{7}$ = $95.70/day; $\frac{\$670.00}{92.8}$ = $7.22/linear ft channel; $\frac{\$670.00}{1000}$ = $0.67/lb. sample

little if any mineralization occurred along the fault, even though rather intense brecciation is present.

Development and Production

From the surface outcrop an inclined shaft was driven down the 25° dip for approximately 700 ft. It was then decided to intersect the vein at depth, because of favorable topography, by driving a horizontal tunnel from the surface. The vein, dipping between 30- and 40°, was encountered over 1200 ft from the tunnel portal. Drifts were then driven (until the vein pinched-out) at regular intervals updip from the inclined shaft. About ten drifts, each several hundred feet long, were driven. Tabular stopes were mined-out, leaving pillars of ore to support the roof. No cross-cuts of any length were driven from the drifts.

Approximately 1000 ft of track are in the mine, and a one-ton car was used to tram ore and waste. A gasoline-powered engine served to hoist the car, using a windlass and a steel cable. According to the owner, one to two train-carloads of ore had been mined per month intermittently since 1948 by two miners, up to the time of the writer's visit in July, 1956. Mining was accomplished without mechanical equipment during the last phase of the activity. Ore was shipped to the Hayden smelter from 1948, although earlier, a 20-stamp mill capable of treating 70 tons per day was constructed on the property. The mill has not operated since 1917. The only production reported in *Arizona Metal Production* was $30.-000 in 1916-1917, but old newspaper accounts (*The Prescott Journal-Miner*) indicated an $18,000 bullion shipment in 1912.

Sampling Technique

The preliminary examination indicated that the vein was persistent, of good width in the lowermost workings, and had a good chance of continuing down-dip until the metamorphic-granite contact was reached, and perhaps beyond. It was estimated that the extension could be at least 1000 - 2000 ft, thus allowing for an inferred reserve of between 138,000 and 276,-000 tons of mineralized rock. (It had not yet been proven to be "ore" in the technical sense.) This tonnage is small, but conceivably could supply a 50-100 tpd mill for about 7-14 years. Vein-extension possibilities were considered good; now the property was considered an ore-exploitation prospect. It became apparent that financial, transportation, milling, ore dressing, water, power, and mining problems could be kept to a minimum. However, knowledge of ore *grade* was limited to statements by the owner and miners.

It was decided that a geologic sketch map by Brunton and tape was warranted, but only of the lowermost level. Selective, or grab sampling was ruled out because of the reported "pockety" nature of the gold. No results of previous sampling were available, and so spot checks were unnecessary. No samples were taken of the small ore pillars left in the upper stopes, because the prospect's potential value depended on grade of a large tonnage not yet developed.

As all upper workings had been relatively mined-out, it was decided to sample only the lowermost drifts where accessible. It was impossible to sample up-dip on the 700 ft level—as raise-stope walls were sheer and the vein 40 ft above the floor. Special scaffolding would have been necessary, and limitations of time and money prohibited its erection. The next drift upward extended only 15 or 20 ft to the northwest, and not at all to the southeast, so it was further decided that sampling here would be valueless. In addition, the nearest drift to this one was over 60 ft up-dip, on one side, and at least two times this on the other side of the raise. Sample correlations would have been most difficult. Since the lowest drift had not been worked in many years, and the 1200-ft tunnel had caved 150 ft from its portal, 54 ft of ladders had to be built in order to make this part of the mine accessible.

All samples, with two exceptions (these being chip samples because of the extreme hardness of the quartz), were of the channel type, averaged 5 in. wide by 3 in. deep across the thickness of the vein, and were cut normal to the strike. Because of the reported spotty, disseminated character of the gold, deviation was allowed from standard 1½ to 4-in. wide channels one in. deep. The average mineralized zone thickness was 5 ft-2 in.; channels varied from 2 ft-10 in. to 9 ft. In every case, both hanging and footwall rock was included for at least one foot on either side of the vein.

All samples cut were 20 ft apart. The rock face was always brushed clean, and washed where necessary. Cuttings were retained on a 10-ft square canvas laid below the channel. A wooden box was used to deflect chips downward, thus preventing their scattering while moiling. Two men alternated between single-jacking and holding the deflection box. Approximately 1000 lb of sample averaging 55½ lb each were secured with wire and sealing wax in sturdy canvas sacks, and taken in for assay. Since no crushing or splitting equipment was available, it was decided to allow the assay office to perform this task.

The 18 samples (92.8 linear ft) represented 340 ft of gold vein, anc one quartz wedge within the fault zone 355 ft from where the vein is faulted off (station 139). The sample averaged 10.8 lbs/linear ft.

Sampling Results

Average weighted value of the quartz vein was $3.45/ton. It is of interest to note that the arithmetical mean assay value was $3.37/ton. The maximum value per ton (gold minimum value, $0.61. Maximum and silver combined) was $11.99; the value of gold was $11.20/ton; the mimimum value, zero. Maximum silver value was $1.44/ton, and the minimum value was $0.56/ton.

Gold varied from a trace to 0.32 oz/ton, and silver varied from 0.62 oz/ton to 1.60 oz/ton.

The existence of one ore-shoot was established (see map), which if 15 ft wide, and containing $12 Au-Ag/-ton over a thickness of 5 ft for 100 ft up-dip, and for 65 ft down-dip (to intersection with the diabase dike) would contain only 1000 tons of probable ore.

Exploration Consideration

1 Contacts: A chance could exist for much higher values on the northern side of the diabase dike where it intersects at depth with the gold vein, *providing* some Au-Ag mineralization was post-dike emplacement. This is entirely possible, considering that post-vein movement has been demonstrated be medial gouge and breccia. This movement could have been accompanied by second generation Au-Ag and/or sulphide mineralization as well. Circulation would become impeded at the dike, and partial stagnation would follow, thus producing more complete Au-Ag precipitation.

Further down dip, the contact between granite and schist should also be tested, as it is a likely place for an oreshoot to occur. This spot is especially vulnerable to fracturing because of stresses imposed during adjustments accompanying and following intrusion.

2 Lithology: Possibilities of the

vein continuing to be mineralized as long as it remains within granite are considered excellent. The reason for this interpretation is twofold. First, granite is a competent rock; one which fails by fracturing thus produces a strong, permeable channelway. Second, the precipitating power of a granite wall rock is considered to be better than that of schist. A change in mineralogy with change in wall rock is anticipated, with a strong likelihood of a change for the worse rather than for the better in the schist. There is, nevertheless, a rather remote chance of finding the schist zone mineralized, and it should ultimately be tested by deep drilling.

3 Structure: Should the vein flatten appreciably down dip, an increase in grade could be predicted. Changes in mineralogy generally accompany changes in dip. This is due to vein swelling with lessening of dip, and consequent increase in mineralization. This is brought about by the rock's response to certain mechanical principles involving components of stress, nature of the rock, and conditions of deformation.

The investigation, admittedly incomplete, did result in the feeling that a "cymoid structure" was developing. This is a reverse curve in which a vein swerves from its course and then swings back again, resuming a direction parallel to its former course, but not in line with it. Such a feature was suggested by a change in dip from 25° at the surface, to 40° at a depth of 700 ft. Also, a "cymoid loop" is suspected to be developing at the 700-ft level. This is a splitting of the vein, with one branch swerving aside to execute a reverse curve, while the other branch continues straight for a short distance, and then executes a similar curve to rejoin the first branch. Drilling to test a possibility of the structure making ore after it has swung back to the oblique direction should be considered.

The Weakest Link: Conclusion

Once the sample results were known, it became apparent that the weakest link was ore grade. Of equal importance was the limited inferred and probable ore tonnage. Balancing the cost of closely-spaced, deep, exploration drill holes against chances for successfully increasing grade and quantity of commercial mineralization down dip, led to the conclusion that the risk was not justified at that time. Especially so, since the prospective purchaser was not prepared to finance a relatively expensive exploration program.

Economics of mining and milling $3.45 rock precluded operating at a profit. The apparent limited amount of $12 rock (at $35/oz gold) would be of little interest to anyone other than hand miners operating on a very small scale. Accordingly, a negative recommendation was made to the potential mine purchaser at the time of the examination.

Future considerations could alter this conclusion, however. A change in gold price, for example, might attract exploration capital to test down-dip possibilities for ore extension.

The writer would like to thank Mr. Ira Joralemon, Dr. Donald Carlisle, and Mr. Donald E. Pruss of Geodynamics, Inc. for their critical reviewing of the manuscript.

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Exploration Costs of Small Mines

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THIS INFORMATION is for small mine operators and those who might become interested in small mines. At the outset it must be realized that seldom will cost figures, as given, fit exactly a given mine: they are presented to help the potential operator make reasonable estimates of the capital needs and the operating expenses involved in exploration and development of small mines.

For discussion purposes, let us assume that the prospector has found a promising outcrop, mineralized zone, or geological structure, indicating the possibility of an ore deposit; and that he has properly located and recorded a claim or claims to cover the area. Also, that the prospector has sampled the outcrop or zone by taking samples from trenches or test pits that have been dug into the solid rock of the outcrop or zone of mineralization.

If the samples show that ore has been found, a development program can be planned; and, if capital is available, this plan can be put into operation.

At this point many prospectors make a serious error by believing that the material ore is found. The USGS defines ore as follows: "Ore is a natural aggregation of one or more minerals from which useful metals may be profitably extracted." It requires considerable mining and metallurgical experience to determine if the valuable minerals found can be "profitably extracted" and if the material is actually "ore".

The wise prospector, before he proceeds further, will obtain the services of a competent mining engineer or mining geologist. While the cost of obtaining such services may seem high, the advice given the operator in most cases will save many times the cost of the services.

When the preliminary work they recommended has been

Table 1—Break Even Ore Values for Small Mines

Type of ore	Grade %	Total value	Return to shipper*
Gold-silver		$ 22.00	$ 16.00**
Copper (at 32¢ lb.)	4	25.60	16.00
Lead (at 12¢ lb.)	15	36.00	16.00
Zinc (at 13¢ lb.)	25	65.00	16.00

*Freight paid by smelter.

**Mining cost at $12.00 per ton plus miscellaneous costs at $4.00 per ton.

Table 2—Small Mine Pay Scale

Worker	Base Pay	Actual Cost*
Miner	$15.00	$18.69
Mucker	14.00	17.44
Foreman	16.00	19.93

*Cost to the mine operator is figured as follows:

Miner's base pay	15.00
Add 1/6 of weekly overtime	1.25
Payroll wage per day	16.25
Social Security (3% of $16.25)	0.49
Unemployment (3% of $16.25)	0.49
Industrial Insurance (9% of $16.25)	1.46
Actual cost per shift	$18.69

completed (i.e., trench sampling, test pitting, and minor drilling), the information obtained must be carefully appraised. If the drilling has shown that no valuable minerals are likely to be found, the claims should be abandoned. Only when the results indicate ore, should the next step be planned.

The accompanying table gives a rough estimate of the "break even" grade of material for small mines. If the exploration indicates material of better grade for any single metal than is shown in the table, the mine might be profitable.

The "break even" grade of ore for the small mine operator must return $12 per ton to cover direct mining costs; $1.60 for royalty at 10% of the smelter or ore buyer's return; approximately $1.50 for trucking from mine to railroad; and a balance of $0.90 out of the total of $16.00 may be used for taxes, insurance, exploration, legal costs, and surveying.

Under very favorable conditions, a small mine operator may be able to produce and ship for less than $16.00 per ton, whereas the cost of other operations having less favorable conditions may exceed $16.00 per ton. The final cost figure will depend upon such items as width of vein, strength of the ore and wall rocks, cost of transportation, royalty, ability of the mine operator, type of labor, and cost of supplies. The values given are for estimating purposes only. An ore buyer or smelter representative should be consulted for detailed information.

If, however, the gross value of the material discovered by the exploration thus far is equal to or greater than shown in the table (after adjusting for changes in market value) the next step can be planned and executed—a general plan for underground exploration.

The base pay of mine employees is only part of labor to the operator. Substantial amounts in the form of insurance and taxes must be added to the base pay. These include:

1. Overtime at the rate of 1.5 times the base pay for the sixth day. This overtime, for accounting purposes, is distributed equally to each of the six days to obtain the so-called "payroll wage". All insurance and taxes are computed from the payroll wage and not the base pay.

2. Social Security at the rate of 3%.

3. Industrial Insurance (industrial accident and occupational disease insurance) at the rate of 9%.

4. Unemployment compensation—state and federal—which adds another 3%.

Other possible benefits could include paid vacations and holidays, shift differentials, group insurance, etc., all of which would increase the total cost shown in the tables.

At this point, plans must be made for the mine surface-plant. The type and size of this plant will vary somewhat. For example, if the headframe to be built is for sinking and exploring with a sinking bucket, it would cost less than one designed for a vertical or inclined shaft with a skip. However, the latter type headframe can be used more efficiently for production.

The cost of a semi-permanent installation which can be used, with some addition, for production is estimated at $3,490. A temporary plant could be installed at a lower cost but must be replaced if the mine produces. Also, the cost of roads for access and other purposes must be added to the total. Distribution of the costs for a mine surface plant are shown in the following table.

The above estimates provide for a hoist, shop and storage shed to be a 12x30-ft building, costing $4.00 per sq ft.

The next step in the exploration program is the sinking of the exploration shaft to examine the mineralized area at depth. This shaft should be put down in the ore body or mineralized zone wherever possible.

Table 3—Shaft Sinking

Labor	Cost per shift
1 Working foreman	$ 19.93
1 Miner	18.69
1 Mucker	17.44
1 Topman (hoisting, etc.)	18.69
Labor cost per shift	$ 74.75
Miscellaneous costs	49.83
Total cost per shift	$124.58

A satisfactory small mine shaft, whether vertical or inclined, is 6x9 ft in cross-section, giving two compartments 4x4½ ft and 3x4½ ft, inside timbers. Costs for this job may be figured as follows:

The figure of $49.83 for miscellaneous costs is based on experience which indicates that for small mines the labor cost will average 60% of the total and miscellaneous costs will average 40% of the total cost. Therefore, $74.75 divided by 60 times 40 equals $49.83.

The cost of sinking a 100-ft shaft will depend upon the advance possible per shift, and for the four-man crew would vary as follows:

Table 4—100-ft Shaft Cost

Advance Per Shift	Cost Per Foot*	Total Cost 100-ft Shaft
1.0 ft	$124.58	$12,500.00
1.5	82.98	8,300.00
2.0	62.29	6,200.00

*Includes all operating costs; labor, supplies, repairs, etc.

For a small mine, the usual size of a drift is 5 ft wide and 7 ft high. This will allow for a track with 18-in. gage, a ditch, and pipes for air, water, and ventilation. When working in bad ground, however, the drift should be driven 6x8 ft in rock section to allow for timbers.

For drifting and crosscutting, the basic costs for labor with a four-man crew will be identical with the costs in shaft-sinking, i.e., $74.75 per shift for labor, and $49.83

for supplies, for a total cost per shift of $124.58. When working in good rock with two headings open, an extra mucker at $17.44 per shift may be used to advantage, thereby lowering the cost per foot of advance.

In reasonably good ground, the crew of four should advance 4 ft per shift. In ground requiring timbering, the advance for the four-man crew would be 3 ft or less. But if two drifts are being advanced, a mucking crew of two men can be working in one drift while the miner, with the foreman's help if needed, can be drilling in the other drift. These various conditions would give the following costs:

Table 5--Drifting in Good Ground

Crew	Heading	Advance per shift	Cost per foot
4	1	4 ft.	$31.15
5	2	5 ft.	24.92
	Drifting in bad ground		
4	1	3 ft.	41.53

These costs include the laying of track and pipe, etc.

These costs include the laying of track and pipe, etc. The amount of drifting needed to prove or disprove the value of the property will vary greatly. In some instances, it will be necessary only to check diamond drilling results; in the case of small but high-grade ore shoots, considerable drifting may be required. Unless the definite amount of drifting can be determined in the beginning of the underground exploration, about 300 ft tentatively may be planned.

Raising usually is done while other mining phases are being carried on. Thus, the cost per ft is materially reduced, since supervision and hoisting are available without much additional cost. In good ground a two-man crew should advance a 4x7-ft raise 3 fpd. The total cost would be approximately $600 per day, or $20 per ft. Chute raises, 12 ft long, will cost upwards of $15.00 per ft, not including cost of the chute.

The major equipment items for small mines may be rented or purchased. During the exploration stage it is advisable to rent this equipment and thereby materially reduce the initial capital outlay. Furthermore, equipment may be obtained on a rental-purchase agreement in which 75 percent of the rent may be applied to the purchase price.

The accompanying tables list the equipment which may be rented and that which should be purchased, together with the cost of each.

Supplies that are consumed during the operation, such as powder, fuse, detonators, bits, drill rods, and timber, were included in the cost of shaft sinking, drifting and raising, as presented in the preceding computations. The supplies which are part of the capital expenditure, and have not been included in the previous costs, are given in the table headed "Supplies."

Under good supervision and favorable conditions, the total costs may be reduced substantially. However, under poor supervision or adverse conditions, the costs will be considerably higher. These cost figures are given only as guides to the small mine operator or the investor in small mine exploration. No two explorations are exactly alike, and no two operators have identical costs; therefore, the above cost figures, although derived in part from actual small mine operations, will correspond to a given exploration only by chance.

Table 6--Equipment to be Rented

Item	Cost new	Rent per month
Hoist for skip or bucket		
2600 lb. rope pull	$ 1,662.00	$120.00
1000 lb. rope pull	1,000.00	80.00
Compressor – rotary		
125 c.f.m. gas	4,900.00	210.00
250 c.f.m. gas	8,900.00	300.00
365 c.f.m. Diesel	14,360.00	575.00
Drilling machines		
2 45-lb. Airleg (each)	1,080.00	83.00
1 100-lb. Stoper	1,250.00	75.50
Air Receiver	Installed	200.00

Table 7--Used Equipment to be Purchased

	Estimated cost
3 mine cars (18 cu. ft.)	$ 300.00
1 pump (air driven duplex)	100.00
1 truck (1 ton)	1,500.00
1 mine fan (10" gas engine drive)	300.00
Auxiliary hoisting equipment – skip, sheave, cable, etc.	400.00
Total	$2,600.00

Table 8--Supplies

Miscellaneous supplies	Estimated cost
Track:	
2 tons 12-lb. rails, used	$ 360.00
Ties, plates, spikes, etc.	150.00
Pipe	
500 feet 2½ inch black iron at 98¢ per foot (new) for compressed air line	490.00
500 feet 1 inch galvanized at 32¢ per foot (new) for water pipe	160.00
Fittings, valves, unions, etc.	200.00
Ventilation:	
450 feet 10-inch galvanized sheet metal pipe	675.00
Pipe fittings	60.00
Drilling:	
2 50-foot lengths of 1-inch hose and fittings	75.00
2 50-foot lengths ½-inch water hose and fittings	55.00
2 line oilers	50.00
General tools:	
Shovels, picks, saws, wrenches, anvil, forge, etc.	500.00
Miscellaneous:	
Surveying, assaying, etc.	300.00
Total	$3,075.00

Table 9--Summary of Costs

Item	Estimated cost
Surface plant	$ 3,490.00
Shaft	
100 feet at $82.98	8,300.00
Drifts	
300 feet at $31.15	9,350.00
Equipment purchases	2,600.00
Miscellaneous supplies	3,075.00
Total	$26,815.00

Many good small mines fail because there is not enough capital available for development, equipment, payroll, and supplies. This capital must be sufficient to meet the costs outlined above, plus a working capital of at least $5,000.00 additional, to permit the mine to carry through the early stages to the period of profitable returns. This means that adequate, financing should be assured before exploration or mining starts.

NO TWO mines are alike, no two costs the same. But open pits, with their low production costs, make mining profitable.

The Open Pit: Low Cost & High Production

Table I, Summary of Berkeley Pit Costs, Six-Month Average (As of Feb., 1959)

	Cost Per Ton of Material
Blasting:	
Blasthole drilling	$0.0032
Blasthole drilling power	0.0004
Blasting	0.0131
Repairs to drill equipment	0.0010
Total Blasting	$0.0177
Shovel Loading:	
Shovel loading	0.0141
Shovel loading power	0.0012
Repairs to shovels	0.0087
Total Shovel Loading	$0.0240
Truck Haulage:	
Truck haulage	0.0558
Road maintenance	0.0021
Dump maintenance	0.0028
Repairs to trucks	0.0285
Repairs to tractors	0.0067
Repairs to graders	0.0007
Repairs to service trucks	0.0014
Total Truck Haulage	$0.0980
Crushing, Conveying, and Loading Ore:	
Crushing, conveying, and loading ore	0.0080
Crushing, conveying, and loading ore power	0.0012
Repairs to diesel locomotives	0.0001
Repairs to crushing plant, conveyor, and bins	0.0030
Total: Crushing, Conveying, and Loading Ore	$0.0123
Miscellaneous Expenses:	
Superintendence, technical, and clerical	0.0112
Service and other miscellaneous	0.0148
Service and other miscellaneous power	0.0003
Fire expense	0.0001
Move power lines	0.0004
Maintain airways	0.0007
Maintain airways power	—
Move miscellaneous equipment	0.0001
Holiday pay	0.0017
Workmen's compensation	0.0020
Vacation allowance	0.0017
Unemployment tax	0.0009
Federal insurance contribution	0.0020
Total, Miscellaneous	$0.0359
Total	**$0.1879**
General expense	**0.0406**
Total	**$0.2285**
Amortization of Development:	**0.0172**
Total: All Expenses	**$0.2457**

Source: **Mining Engineering**, March 1959, p. 294 and **The Anaconda Co.**

IN GENERAL, the cost of open-pit mining (breaking, loading, and hauling) varies from about 20¢ per ton to about $1.25 or higher—depending on the size of operation, kind of material and distance it is moved.

For large pit operations (over 1000 tpd), direct mining costs are generally around 25¢ per ton, regardless of rock type (except perhaps, for taconite). Reports from mines that are widely scattered geographically (see also reports in other sections of the Guidebook), show figures such as the following: 25¢ and 22¢ for two copper pits, 23¢ for an iron mine, 24¢ for a uranium pit and 28¢ for an asbestos pit. (The latter is a two-shift per day operation in hard rock.)

The lowest cost figure available was reported by Norman A. Grant, production manager, uranium department, Tidewater Oil Co. In an article in THE MINES MAGAZINE, April 1961, Grant wrote about a bucket wheel excavator, rigged with 2½-yd buckets, that moved overburden a distance of one mile over a 42-in., 1800 fpm conveyor for a cost of 7¢ per cu yd. Density of the material isn't known but the per-ton cost should be about 60% of the per-yard cost.

The highest cost per ton figure is for taconite. One expert several years ago estimated costs for mining this material at $1.25 per ton.

In the Guidebook, so far as possible, direct mining costs will include only the cost of rock breaking, loading and hauling the material out of the pit.

Cost-per-ton tends to decrease with increased production, larger equipment (assuming it is run full-time), decreased haulage distances and easier handling material. There are many other production factors which enter into the cost picture, some of which are covered in more detail in the following pages.

The tables in this section were selected (1) because they were available (not many companies are willing to discuss costs) and (2) because they represent different types of mining.

Berkeley's Costs Are Low

Take the Berkeley copper pit for example (Table 1). This is a modern, efficient operation with a relatively low cost per ton. Its under-2¢-per-ton figure for blasting is comparable to some of the best coal mine figures. (Drilling and blasting can go over a dime—or even over a quarter—in small operations.) Shovel loading is also low at about 2½¢ per ton and is due, in part, to the high production figures from the BE 150-B's. Some of these shovels, it is reported, have loaded over 10,000 tons per shovel shift, mostly because of the excellence of blasting. The average is 6710 tons.

Moving material out of the pit is also cheap at Berkeley: about a dime. However, the Berkeley ores have to be moved by rail to Anaconda, some 27 miles distant. If the haulage amounts to 2¢ per ton mile (an approximate estimate for this type of operation), an additional 22¢ per ton of total material would be added before the ore was treated (based on a stripping ratio of 1.5 to 1).

Drilling at Berkeley is by 6¼- and 9-in. rotaries, blasting by AN/FO, loading by 6-yd electric shovels and hauling by 34-ton trucks. Ore is crushed in the pit and transferred by conveyor to the railroad.

Of course, mining costs are usually calculated in advance in relation to ore grade, tonnage, stripping ratio and expected profit. Adolph Soderberg, in MINING CONGRESS JOURNAL, April 1959, explained the formulas used by Kennecott. It is interesting to note that, while a 45¢-per-ton figure was used for mining in all cases, the cost of removing waste varied with the tonnage (Table 2). Here the cost-per-ton of mining waste increased with the increased tonnage to be removed. This corresponds with the increased distance needed to remove the waste from the pit area. The variation is significant, ranging from 36¢ per ton for moving 155-million tons of waste to $1.00 per ton for 250-million tons of waste.

Table 2, Comparative Economics—Fixed Tonnage Production

Cut-off	0.6% Cu		0.5% Cu		0.4% Cu	
	Tons	Avg % Cu	Tons	Avg % Cu	Tons	Avg % Cu
Ore	100,000,000	0.90	100,000,000	0.90	140,000,000	0.80
			40,000,000	0.55	55,000,000	0.45
Total Ore	100,000,000	0.90	140,000,000	0.80	195,000,000	0.70
Tons Waste	250,000,000		210,000,000		155,000,000	
Stripping Ratio	2.5:1		1.5:1		0.8:1	
Annual Production:						
Ore	5,000,000 tons		5,000,000 tons		5,000,000 tons	
Copper	80,000,000 lb		70,500,000 lb		61,000,000 lb	
Tons Per Day:						
Ore	16,000		16,000		16,000	
Waste	40,000		24,000		13,000	
Total	56,000		40,000		29,000	
Plant:						
Mine	$28,000,000		$20,000,000		$15,000,000	
Mill	24,000,000		24,000,000		24,000,000	
	52,000,000		44,000,000		39,000,000	
Life	20 yr		28 yr		39 yr	

	Per ton	Per lb Cu	Per ton	Per lb Cu	Per ton	Per lb Cu
Costs:						
Mining	$0.45		$0.45		$0.45	
Stripping	1.00		0.64		0.36	
Milling & General	1.25		1.25		1.25	
	2.70	16.9¢	2.34	16.6¢	2.06	16.9¢
Treatment, etc.		5.9		6.0		6.2
Total Cost		22.8¢		22.6¢		23.1¢
Profit @ 30¢ Cu:						
Per Lb	7.2¢		7.4¢		6.9¢	
Annual Income	$ 5,760,000		$ 5,217,000		$ 4,209,000	
Amortization	2,600,000		1,571,000		1,000,000	
	3,160,000		3,646,000		3,209,000	
Depletion	1,580,000		1,823,000		1,604,000	
Taxable Income	1,580,000		1,823,000		1,605,000	
Tax @ 52%	822,000		948,000		835,000	
Net Annual Profit	4,938,000		4,269,000		3,374,000	
Total Profit	98,760,000		119,532,000		131,586,000	
Payout	10.5 yr		10.3 yr		11.6 yr	
Present Worth @ 6 & 3:						
Factor	10.29		12.01		13.54	
Amount	50,812,000		51,271,000		45,683,000	
Less Plant Capital	52,000,000		44,000,000		39,000,000	
Net Present Worth	(1,188,000)		7,271,000		6,683,000	

Source: MINING CONGRESS JOURNAL, April, 1959, p. 58.

Costs in the iron country can be expected to be higher because of the nature of the material being mined. The average cost per ton for open pit mining in Michigan was 98½¢ in 1959 (Table 3). That this was only a small part of the total cost of mining is apparent from examining the figures. By the time the deferred costs, taxes, general overhead, transportation, marketing, royalty and federal taxes were added, the cost jumped to $5.63 per ton.

The ratio of labor costs to supplies was 42 to 56 in Michigan for 1959. An examination of mine equipment unit costs of the Copper Cities Div., Miami Copper Co., gives a similar

Table 3, Michigan Siliceous Open Pits (Iron)
Average Costs per Ton ($)

	1958	1959	5-yr. Avg.
Costs of Mining			
Labor	.5763	.4211	.5342
Supplies	.5966	.5645	.5725
	1.1729	.9856	1.1067
Deferred Costs	.2188	.0561	.0659
Taxes			
General Property	.1952	.0518	.0610
State Corporation	.3371	.1702	.0968
Social Security	.0221	.0184	.0218
	.5544	.2404	.1796
General Overhead			
General Office	.2409	.3019	.1290
General Superintendence	.0831	.0527	.0564
General Insurance	.0063	.0246	.0324
Other Expense	—	—	—
Employee Insurance	.0474	.0517	.0416
Depreciation	.0961	.1315	.1171
	.4738	.5624	.3765
Transportation			
Rail Freight	1.0575	.9900	.9752
Boat Freight	2.0784	2.0800	1.9985
Cargo Insurance	.0024	.0027	.0028
	3.1383	3.0727	2.9765
Marketing			
Selling	.0443	.0498	.0498
Analysis	.0082	.0073	.0073
	.0525	.0571	.0571
Total direct ore costs	5.6107	4.9743	4.7623
Other Reported Costs			
Royalty	.0951	.0953	.1043
**Federal Income Tax	.3022	.5593	.3405
	.3973	.6546	.4448
Total	6.0080	5.6289	5.2071
*Lake Erie Value per Ton	6.2819	6.2182	5.9945

*Computed L. E. price adjusted for sulphur analysis.
**Not reported for all mines.
Figures compiled by H. J. Hardenberg, Appraiser of Mines, and R. C. Reed, Mining Geologist, Dept. of Conservation, Geological Survey Div.

Table 4, Mine Equipment Unit Costs, Copper Cities Div., Miami Copper Co. (As of June 1958)

		Percentage Breakdown
Rotary drill		
Operation:		
Labor	30.56	
Supplies	20.17	
Total operating		50.73
Repair:		
Labor	26.39	
Parts and supplies	8.16	
Miscellaneous	14.72	
Total repair		49.27
Total cost		100.00
Loading, 5-yard shovel		
Operating:		
Labor	27.17	
Supplies	2.87	
Power	2.63	
Miscellaneous	28.14	
Total operating		60.81
Repair:		
Labor	16.03	
Parts	23.16	
Total repair		39.19
Total cost		100.00
Haulage, 40-ton trucks		
Operating:		
Labor	39.50	
Tires	18.48	
Petroleum products	11.16	
Supplies	2.71	
Total operating		71.85
Repair:		
Labor	18.05	
Parts and supplies	8.67	
Miscellaneous	1.43	
Total repair		28.15
Total cost		100.00
Haulage road (approx. 7 % of haulage cost)		
Operating labor	23.08	
Maintenance	1.23	
Operating supplies	4.10	
Equipment used*	69.51	
Miscellaneous	2.08	
Haulage road costs		100.00

*Light trucks, bulldozer, carryall, and other equipment charged at hourly rate × hours used.
Source: Bureau of Mines Information circular 7985, p. 51.

breakdown of labor in relation to supplies (Table 4). For a rotary drill (operating and repair combined), labor constituted 57% of the total cost; for loading, 43%; for haulage, 57½%. These figures were given in February, 1958.

Table 5, which shows production costs of Getchell Mine Inc.'s tungsten mines for 1950-1956, illustrates cost fluctuations. Costs were high at Getchell because of the long 7- to 12-mile truck haul to the mill. Getchell's stripping costs, however, were estimated at 30¢ per ton. These mines were made tungsten producers in 1950 because of the Korean War.

In the uranium pit operations in the Gas Hills area of Wyoming, total mining costs run from $4.63 per ton direct ore up to $10.00, with the average around $6.00 or $7.00. The $4.63 figure was reported by Vitro Minerals Corp. which also gave an 87¢-per-ton figure for lifting. Since Vitro's stripping ratio is about 1 to 18.5, the cost boils down to 23.7¢ per ton of total material mined.

Roy Coulson, division superintendent, Vitro Minerals Corp., reported the costs in MINING CONGRESS JOURNAL, November 1960. He also wrote that Vitro's dragline stripping averaged about 18¢ a yd (the cost-per-ton figure would be about 60% of the cost-per-yd figure), with an additional 4¢ a yard tacked on for blasting. When Vitro changed to rubber-tired scrapers, the average direct cost ran about 17¢ per cu yd.

Table 6 shows a breakdown of costs at Mt. Morgan Ltd.'s copper-gold pit in Australia for 1960. This is a medium-size operation with a

Table 5, Production Record of Pits in Operation from 1950-56, Getchell Mine, Inc. (tungsten-gold)

Name	Tons 1950	1951	1952	1953	1954	1955	1956	Total
Alpine	2500	41,200	—	—	—	—	—	43,700
Moly	2400	10,300	—	—	—	3100	8800	24,600
Tip Top	—	2700	8800	15,000	3100	7300	300	37,200
Kirby	—	—	25,000	9600	—	—	—	34,600
Top Row	—	—	—	2800	—	—	—	2,800
Riley Ext.	—	—	—	4500	23,400	—	—	27,900
Pacific	—	12,500	73,600	72,700	35,800	30,500	45,600	279,700
Marcus	—	—	—	—	—	7100	14,200	21,300
Totals	4900	75,700	107,400	104,600	62,300	48,000	68,900	471,800

Cost of Breaking, Shoveling, and Hauling ($ per ton of Wet Ore)

	1951	1952	1953	1954	1955	1956	Average
Primary breaking	0.21	0.29	0.19	0.38	0.36	0.19	0.27
Secondary breaking	0.01	0.08	0.12	0.17	0.28	0.15	0.12
Shoveling & hauling	1.80	1.70	1.69	1.48	1.65	1.46	1.64
Total	$2.02	$2.07	$2.00	$2.03	$2.29	$1.80	$2.03

Breakdown of Cost of Equipment Hauling Ore ($ per ton of Wet Ore)

	1951	1952	1953	1954	1955	1956	Average
Shoveling	0.39	0.43	0.44	0.45	0.46	0.40	0.43
Hauling	1.20	1.06	1.12	0.93	1.06	0.96	1.06
Tractor	0.09	0.09	0.03	—	—	0.03	0.05
Patrol	0.12	0.12	0.10	0.10	0.13	0.07	0.11
Total	$1.80	$1.70	$1.69	$1.48	$1.65	$1.46	$1.64

Source: E&MJ, August, 1957, p. 91.

Table 6, Costs at Mount Morgan Ltd. (Copper, Gold), Australia

Cost per ton of total material mined
(£A = $2.24)

	s.	d.	¢
Drilling		7.5	7.00
Blasting		7.8	7.28
Shovelling		10.5	9.80
Bulldozing		3.8	3.55
Transport	1	8.3	18.95
Dumps/Roads		1.8	1.68
Crushing		2.1	1.96
Haulage		3.4	3.17
Air/Water		1.0	0.93
Pumps		1.0	0.93
Power		1.8	1.68
Administration		1.7	1.59
Other costs		2.7	2.52
Total	5s.	6.7d.	62.25¢

Equipment costs

Drilling	per ft	¢
Churn drill	8/10	98.93
Crawl-IR	3/—	33.60
Wagon drill	3/5	38.27
Jackhammer	4/9	53.20

Shovelling (maintenance, labor & parts)	d/ton shovelled	¢
5 cu yd	3.0	2.80
2½ cu yd	7.4	6.91
1½ cu yd	1/2.2	13.25

Bulldozers (maintenance, labor & parts)	per hour	
Caterpillar D8	£3/11/7	$8.017

Note: Costs are for 11 periods to 1/5/60
Rate of mining: 361,000 tons/period

Source: MINING & CHEMICAL ENGINEERING REVIEW, Jan. 16, 1961, p. 64.

Table 7, Summary Analysis of Major Cost Elements, Superior Quarry, Marquette Cement Mfg. Co. (1956)

Operations	Operating labor	Supplies	Repairs	Fuel	% of total stone cost
Drilling and shooting (o. b.)	$ .028	$ .156	$ .023	$ .004	21.2
Stripping	.070		.127	.026	22.3
Hauling and road maintenance	.071	.010	.191	0.19	29.1
Total for major operations					72.6%

Repairs	Cost per ton	% of total repair cost
Stone wagons	$ .170	41.7
Dragline	.103	25.2
Bulldozers	.037	9.0
Total for Major Machines		75.9%

Repairs	Cost per ton	% of total repair cost
Repair parts	$ .261	64.6
Repair labor	.047	11.6
Outside services	.096	23.8
Total	$ .404	100%

Wagon Repairs		Dragline Repairs	
Tires	70.1%	Cables	36%
Engine	11.0	Bucket	26
Brakes	7.4	Marion Parts	26
Other	11.5	Engine Parts	12
	100%		100%

Source: MINING CONGRESS JOURNAL, Aug., 1957.

medium 62¼¢-per-ton cost. Some of the most revealing figures are those for shovel loading: It costs 13¼¢ per ton to load with a 1½-cu-yd shovel, while only 2.8¢ per ton with a 5-cu-yd shovel. Loading is into 15- and 16-ton trucks. For the 5-yd shovel, the production rate is 380 tph, while it varies from 74 to 89 tph for the 1½-yd shovels. A shovel operator received £18/7/9 per week plus a bonus of £1/7/-per shift for 1960. At $2.24 per £A, this amounts to $41.19 per week plus $3.02 per shift.

Tables 7 and 8 give a breakdown of costs for the Marquette Cement Mfg. Co. in 1956. These tables were presented in an article by David G. Lewis, quarry superintendent, in MINING CONGRESS JOURNAL, Aug. 1957. The article covered, essentially, the cost-savings to be expected by changing methods and equipment.

Of special interest in Table 8 is the high cost of repairs and the breakdown by area. Over 70% of the repair costs for the wagons were on tires (amounting to almost 12¢ per ton), while 36% of repair costs for the dragline were on cables (amounting to 3.7¢ per ton).

Table 8, Summary Performance Records for Operations and Equipments, Superior Quarry, Marquette Cement Mfg. Co. (1956)

Clearing and terracing	
Oper. performance	381 sq ft (.01 acre) cleared/hr
Unit cost	$480/acre
Equipment: oper. cost	Bulldozer $5.08/scheduled hr
utilization	Bulldozer utilization 0.75
Drilling and shooting	
a) Drilling	
Maximum capacity	600 ft/8 hr
Operating performance	280 ft/8 hr
Utilization	47%
Drilling cost	$ .35/ft; $ .025/cu yd
b) Shooting	
Explosive ratio	2.0–2.5 cu yds/lb
Explosive cost	$12.50/cwt (Nitramite)
Unit blasting cost	$ .055/cu yd
Stripping	
a) Dragline	
Bucket factor	4.6 cu yd (bank)/cycle (6 yd bucket)
Maximum capacity	333 cu yds/hr
Operating performance	186 cy yds/hr
Utilization	56%
Unit cost	$ .083/cu yd
Stripping (continued)	
b) Total stripping (including dragline, Lima shovel, bulldozer)	
Unit cost	$ .101/cu yd
Stone preparation	
Maximum capacity	22 holes/hr
Performance	12 holes/hr
	81 tons/man-hour
Overtime hours	20.6%
Explosive ratio	2.9 tons/lb
Explosive cost	$ .062/ton
Total unit cost	$ .112/ton
Stone loading	
Maximum capacity	650 tph
Performance	170 tph
Utilization	31%
Overtime hours	17%
Unit cost	$ .042/ton
Hauling	
Max. capacity (2.2 miles)	111 tons/wagon hr
Performance	50 tons/wagon hr
Utilization	45%
Overtime hours	15%
Unit cost	$ .102/ton mile

Source: MINING CONGRESS JOURNAL, Aug., 1957.

A. B. Parsons reported in *The Porphyry Coppers in 1956* that the direct cost of power shovel mining, exclusive of stripping overburden, was about 12¢ per ton at Bingham in 1930. Costs, of course, have risen considerably since then. For example, one copper expert reported that costs for open pit copper mining in general rose an average of 3.6% per year from 1934 to 1957. (See also the chart on p. 182.)

The direct cost of mining is fairly low, in comparison to other expenses incurred before the metal is sold. U.S. Bureau of Census data for 1954 showed principal expenses (all mines) of $3.00 per ton for iron ore, $4.60 per ton for copper ore, $10.00 per ton for lead-zinc ore, $9.50 per ton for gold (lode), $53.40 for manganese ore and $19.35 for tungsten.

If 1% metallic copper is extracted from a ton of ore and sold for 30¢ per lb, a change of 1¢ per lb in the selling price would be equivalent to a 20¢ per ton change in the cost of mining a ton of ore. For many properties, it would take an engineering miracle to cut costs 20¢ per ton of ore for a savings the equivalent of a 1¢ per lb increase in the selling price of the metal.

Yet many mines are so near marginal that a cost-savings measured in fractions of a cent per ton becomes important. That mining is becoming more cost-conscious is evidenced by the advent of the industrial engineer in the mining industry. (See, for example, "How Industrial Engineering Cut Costs at Kennecott," E&MJ, May 1961.)

Table 9, Open Pit Mining Costs, Eagle Mountain Mine (1956) ($ per ton)

	Drilling and Blasting	Shovel Operation	Truck Operation	Total
Labor*	$0.04	$0.01	$0.02	$0.07
Repairs	.01	.02	.02	.05
Supplies	.02	.01	.01	.04
Special Items**	.06	—	.01	.07
Total	$0.13	$0.04	$0.06	$0.23

*Includes direct supervision, payroll tax, and insurance.
**Chiefly explosives and tires.
Source: Bureau of Mines Information Circular 7735.

Rock breaking and loading are relatively inexpensive parts of operations, sizable cost reductions having been made by large power shovels and low-cost fertilizer grade ammonium nitrate. The real expense begins with haulage and the total transportation expense before the metal is sold accounts for a hefty share of the total cost of production.

Thus, many mining companies are devoting considerable effort to achieving lower cost haulage. Every haulage system but the railroad has recently undergone major change. (Automatic railroads have yet to be developed for mines.)

When it was found that larger trucks generally resulted in economies, their sizes soared until today there is a 95-ton capacity truck available commercially and a 175-ton custom-built truck in operation. When it was realized that tires sometimes accounted for one-sixth of total mining expense, new tires with more plys and some with steel bondings were introduced. Power systems for the trucks also changed, and the new gas turbines, diesel-electrics and electric-trolley trucks promise further economies.

The Germans can be credited with the major advances in conveyor design. The high-speed, deep-troughed belts with long centers have increased production and lowered operating cost. The cable belt system with tension placed on steel cable instead of the belt may offer further economies.

The future of hydraulic transportation of solids through pipelines is another bright spot. One coal system is reported to move material for about 4 mills per ton-mile. Harvey B. Hardy and Svend A. Canariis in MINING ENGINEERING, March 1961, estimated the cost of pumping phosphate slurry through a 2.81-mile pipeline to be 2.96¢.

Table I. Drilling and Blasting Performance in Selected Open Pits

	Product	Formation	Drill-ability	Shovel Size No & Size (Cu Yd)	Tons Per Day	Type & Number of Drills	Average Drill Speed (Ft/Hr)	Type Bit	Size Bit (In.)	Face or Bench Ht. (Ft)	Sub Drill (Ft)	Spacing (Ft)
1	Copper & Waste	Porphyry	Good	5-6 yd	80,000	2 Mediumweight Rotary 1 Lightweight Rotary	70	Tricone	6¼–9	33	7	25–30
2	Copper & Waste	Porphyry	Good	4-5 yd	30,000	2 Mediumweight Rotary	55	Tricone	7⅞	25	10	25
3	Iron Ore	Hematite	Medium	3-5 yd	15,000	1 Heavyweight Rotary 3 Churn	28 9	Tricone T. C.	9	36	2	29
4	Asbestos Ore & Waste	Serpentine-Granite	Med.-Hard	3-3 yd	8,000	3 TM-500 Percussion	40	T. C. Bits	4	45	3	14

	Burden (Ft)	Number of Rows Blasted	Number of Holes Per Blast	Method of Detonation	Type of Primer	Size or Weight of Primer	Location of Primer	Type of Explosive Dry Holes	Type of Explosive Wet Holes	Size or Weight of Explosive
1	21–33	1	7–12	Primacord—ms Connection	Nitromite	1–5-lb Bag	Bottom	Prilled AN—Oil	—	80-lb Bags
2	20	3	30–36	Primacord—ms Connection	Nitromite	1-5½-lb Con	Bottom	Prilled AN—Oil	—	80-lb Bags
3	24	1	4	Primacord—ms Connection	EP 152 Gel.	1–5-lb x 16	Bottom	AN—6% Oil	Nitromite—8-in. x 5-lb Cartridge	80-lb Bags
4	12	3	15–30	Primacord—ms Connection	40% Gel.	1 x 8 in.	Spaced Every 5	AN—6% Oil	3 x 10-in.—40% Gel.	50-lb Bags

Rock Breaking: A Key to Total Cost

DRILLING AND BLASTING (rock breaking), although generally less expensive than haulage, always directly influences loading, hauling and crushing costs. The reported direct-cost range is wide, varying from slightly more than 1¢ per ton to over 70¢.

Table 1 is a selection of pits, widely scattered geographically, that represent different rock types. Each is a major ore producer and each reports total rock breaking costs between 1¢ and 3½¢ per ton of total material broken. However, an examination of tables in the introductory section on pit mining (p 198) and the section on ripping (p 212) give a much wider range of values.

Drills may be divided in the following categories: auger, percussion, churn, rotary, down-hole, combination, and jet piercers. Augers, although fast and cheap, can drill only a limited range of soft material. Percussive drills are generally applicable for small operations and for secondary blasting.

Originally, churn drills were used for most pit operations: they can drill both soft and hard rock under a variety of conditions. The newer drills—high-speed rotaries and down-holes and, more recently, combination drills—were designed to speed drilling and to lower costs.

The first of these, the rotary, has gained acceptance as a high speed, low-cost drill in soft and medium hard rock, but was found more expensive in harder rock formations. Consequently, the down-hole drill was designed primarily as a hard-rock machine. The newer combination drills can be equipped with rotary, down-hole percussive, or out-of-the-hole percussive units.

The economic cut-off point between rotary and down-hole drilling has never been firmly established, nor has a uniform scale of rock drillability. However, a statement by Robert T. Macaul of Ingersoll-Rand before the Eighth Annual Drilling and Blasting Symposium (University of Minnesota, 1958) is believed to be generally applicable through a limited range of rock formations: "Where rotary drills are not exceeding a penetration rate of 50 ft per hr, or roller cone bit cost is in excess of 10¢ per ft, the down-hole drill can normally be expected to effect a cost savings per unit of production."

Thus, there is a primary relationship between total drilling cost, drilling speed and bit cost. MINING CONGRESS JOURNAL developed a scale of 23 rock types in its November 1954 issue. If a line is drawn on this scale through the 1.5 value, it may be possible to classify rocks to the left of this line in the igneous category and say that they will drill faster with down-hole tools while those on the right in the sedimentary class of rock drill faster with rotary tools.

An examination of recent drilling and blasting performance at four mines (two copper, one iron, and one asbestos) show rock breaking cost in relation to total mining cost. With the exception of the asbestos pit (which drills with a heavy-duty, percussive-type, crawler), these mines all use large rotaries primarily. Blasting is with 50- and 80-lb bags of AN.

Case History No. 1—Iron Mine Cost Is 3.2¢ Per Ton

The principal mining equipment consists of one 6-yd, and two 5-yd electric shovels. Two shovels are operated simultaneously for blending ores. Pit haulage is by 34-ton diesel trucks. Drilling equipment is one 60-BH electric rotary drill, and four churn drills. The rotary drill produces most of the tonnage.

Average depth of blast holes is 39 ft, which includes 2 ft of subgrade drilling. The 9-in-dia holes are spaced on 29-ft centers and 24-ft burden. During the 1958 season, tungsten carbide rotary drill bits were used exclusively. Their average life was 3600 ft and the bit cost per lineal foot of hole drilled was 33.5¢. Tons of iron ore per lineal foot of 9-in. drill hole was 37.5 tons.

During the 1958 season the 60-BH rotary drill produced an average of 193 lineal ft per shift. During the same period the churn drills averaged 62.4 lineal ft per shift.

Principal explosive used is prilled ammonium nitrate and 6% diesel oil, which is poured in the hole. In wet holes Nitromon A and Nitramite in 8-in. x 50-lb cartridges are lowered to fill the hole to the top of the water and then the AN is poured in the hole. Reinforced 50-grain Primacord is used in the hole, and for the AN, the booster used is 5-in. x 12½-lb cartridges of EP-152. A single row of four holes constitutes a blast at this property. The trunk line is 50-grain Primacord, with a 17-millisecond delay between holes. The charge is det-

onated with an electric cap tied to one end of the Primacord trunk line.

The cost of explosives at this property: prilled AN—3.6¢ per lb; Nitromon A—18.3¢ per lb; and Nitramite —12.5¢ per lb.

Cost of drilling is 2.5¢ per ton, and the over-all blasting cost is 3.2¢ per ton. Tons produced per lb of explosive is 4.3 tons.

Case History No. 2—Copper Mine, 1½¢/Ton for Drilling

This pit was originally on 50 ft benches, but it was soon found that the orebody was interspersed with waste and close grade control by selective mining was necessary. A changeover to 25 ft bench height was made, and is now standard.

Major mining equipment consisted of 4- and 5-yd electric shovels, 25-ton and 30-ton diesel trucks and rotary blast hole drills.

Accurate sampling, truck sampling and sampling the drill hole cuttings were thought necessary to get a close check. It was found however, that sampling the drill holes every 5 ft gave very accurate results and the other sampling methods were discontinued. For the year 1956, there was a variation of only 0.02% in copper content between the mill sampling and the drill hole samples.

The original drilling was done with 42-T churn drills. Later, a 58-BH electric blast hole drill was purchased. Drilling 7⅜-in.-dia holes, this single rotary drill easily handled the daily tonnage.

The average shift footage of the 58-BH rotary drill was 398 ft. The average shift footage of the churn drill was 55 ft. The average bit life of the 7⅜-in.-dia type W7R tricone bit used on the rotary drill was 3000 ft. This bit costs $190.00; giving an average bit cost per foot of hole of 6.3¢. The over-all cost of rotary drilling per ton blasted was 1.55¢.

Another drill was purchased for stand-by purposes. However, one drill easily took care of the required tonnage. For the standard bench height of 25 ft, the rotary drilled to approximately 35 ft in depth, which took care of a certain amount of sloughing, and insured a net depth of 30 ft, or 5 ft below the bench level. All holes were drilled with 7⅜-in.-dia tricone W7R bits.

The average number of holes per blast was generally 32 to 35, and common practice was three rows of ten to twelve holes per row. The holes were staggered. Hole spacing was 25 ft, and the burden was 22 ft between rows.

The current practice is to distribute the bags of AN prills at the collar of the hole and add one gallon of diesel fuel oil to each 80-lb bag of AN used.

In loading the holes, 80 lb of prills were poured into the hole, then the primer attached to 50-grain Primacord was lowered, followed by 80 lb of prills. To stem the hole, cuttings from the rotary drill were shoveled into the hole to the collar.

The Primacord in each hole was attached to a trunk line of 50-grain Primacord with 9-millisecond and 17-millisecond connectors used in the second and third rows of holes. For the primer in each hole, a 5½-lb can of Nitromite was standard.

The present explosives cost per blast hole, which includes diesel fuel, primer, and ammonium nitrate, but does not include Primacord or millisecond delays, is approximately $8.25 per hole, which compares with the cost of approximately $25 per blast hole when 40% and 60% dynamite was used exclusively. Testing of fertilizer grade AN was carried on during 1956, and was adopted as the standard explosive at the beginning of 1957.

Case History No. 3 Asbestos Pit, Hard Rock

The ore in this pit is asbestos in serpentine rock. The principal mining equipment consists of one 5-yd, No. 4161, two No. 101—3-yd, and one 2¾-yd electric shovels. Pit haulage is by eight Mack diesel trucks, 22-tons capacity. Drilling equipment consists of three TM-500 percussion rotary drills, and one No. 505 twin-drill jumbo.

The TM-500 drills are equipped with 4-in.-dia bits. The bench height is approximately 45 ft, and all holes are drilled 3 ft subgrade. Standard spacing is 14 ft, the burden is 12 ft, and all holes are drilled 60° down, at right angles to the face. The drill holes are on a square pattern, and usually three rows are drilled and blasted.

Drill footage, per shift, of the TM-500 drill, varies from 260 ft to 360 ft, with an average of 285 lineal ft of hole per shift. Bit life averages 14,000 ft in ore, and 6000 ft in granite.

The majority of the holes are dry, and are loaded as follows:

One 3x16-in. stick of 40% gel. dynamite is lowered to the bottom of the hole, along with 50-grain Primacord. At 5-ft intervals along the Primacord, one ⅞-in. stick of 40% gel. is attached to the Primacord, making a total of eight sticks. One 80-lb sack of prilled AN is poured into the hole, followed by one gallon of diesel oil, then a second 80-lb bag of prills is poured into the hole, and another gallon of diesel oil. The total of 170 lb of explosive brings the charge within about 9 ft of the surface, and the top 9 ft is stemmed with dry mill tailings. When some water is encountered in the holes, the 3x16-40% dynamite fills the hole to the water line, and then the prills are added. In any event, the total powder charge per hole does not exceed 170 lb.

Usually three rows of holes are blasted at one time. The three trunk lines are 50-grain Primacord, and the cross lines at each end of the blast are 50-grain Primacord. Fifty-millisecond delays are placed in each end line between the first and second rows, and 50-millisecond delays are placed between the second and third row. The Primacord is triggered with two electric caps, as a matter of insurance, one at each end of the first row of holes.

Six hundred lineal feet of hole per day will produce total tonnage requirements. Total mine crew is 57 men.

At this mine, the direct costs are 19¢ a ton; and indirect costs 9¢ a ton, which makes the over-all cost 28¢ a ton for each ton of material removed from the pit. Inasmuch as the ore tonnage and the strip waste tonnage are equal, the total mining cost per ton of ore is 56¢ per ton.

Case History No. 4 Copper Pit, Under 2¢/Ton

Principal mining equipment consists of five 6-yd electric shovels, one 3-yd diesel shovel, and 34-ton diesel-powered trucks. The drilling equipment consists of three 9-in. 40-R track-mounted electric rotary drills, and one 6½-in. No. 200 track-mounted diesel rotary drill.

In an eight-hour shift, the diesel powered drill averages 604 ft and the electric drill 521 ft.

Standard bench height is 33 ft. Blast holes are spaced 30 ft apart in the ore, and 25 ft apart in the waste, which gives good fragmentation. The distance between the toe and the hole line varies from 21 ft to 33 ft, depending on the type of rock drilled. Depth of blast holes is 38 ft to 40 ft, or 5 ft to 7 ft below bench grade. In

the ore, because of the proximity of dwellings to the pit, a maximum of twelve holes constitutes a blast, and in the waste, the maximum number of holes is seven. The critical amount of explosives in any one blast is approximately 5500 lb when used in conjunction with millisecond delays.

Blasting is done with AN prills of fertilizer grade, mixed with diesel fuel oil, in the ratio of 3 quarts of oil to each 80 lb bag of prills. Current practice is to pour the diesel oil in the AN bags 72 hr before the explosive is placed in the blast holes.

Powder consumption per hole varies from 200 to 400 lb of prills in the waste, and 320 lb of prills in the ore. Several types of primers have been used successfully in the detonating operation. The primer used currently is 5-lb bags of Nitramite.

The standard method of loading blast holes is to pour into the hole two bags of mixed AN prills. Then a 5-lb bag of Nitramite tied to 50-grain Primacord is lowered into the hole, and the balance of the AN for the blast is poured into the hole. The Primacord lead from each hole is tied to a trunk line of 50-grain Primacord, and No. 9 and No. 17 millisecond connectors are placed in the trunk line between each hole. An electric blasting cap placed at the end of the trunk line triggers the blast.

In 1958, total drilling and blasting cost was $0.0177 per ton of material, ore and waste. The over-all cost of material removed from the pit was $0.2285 per ton during the year 1958.

The case histories show a faster penetration speed for rotary drilling in the copper orebodies than in the iron orebody. Inspiration Consolidated Copper Co. reports a drilling speed similar to that reported in case history No. 2—390 ft per shift for a 6¼-in. rotary and 343 ft per shift for a 9-in. rotary (Tables 2 and 3). These figures were reported in MINING ENGINEERING, January 1961

The article was based on a report by Thomas M. Anderson, open pit general foreman, who explained that Inspiration later selected a truck-mounted rotary because of its fast mobility. The tables also reveal relative costs, both rotaries offering economies over churn drilling. Although the cost per ft of the 9-in. rotary was higher than the 6¼-in. rotary, the larger unit offered the best economy in terms of cost-per-ton. This is because a 9-in. drill will give about double the hole volume of a 6¼-in. drill, the volume being a function of the radius squared.

The Mesabi Range Drilling and Blasting Committee recently tabulated numerous drill data from mines working the Mesabi ores. A report by Donald K. Nelson, M. A. Hanna Co., was published in the QUARTERLY OF THE COLORADO SCHOOL OF MINES, Vol. 56, No. 1, January 1961. Much of that report is abstracted here because it includes churn, rotary and down-hole drilling and because it covers a wide range of rock drillability. It is also probably the most complete tabulation of drilling ever published for a given area.

Table 4 is a rock drillability table developed from data obtained by drilling across the ore bearing structure of the Mesabi Range with the same drill. Because cost and drilling speed are closely related to rock drillability, performance data for any particular drill should be evaluated in relation to rock type.

The figures in Table 5, which cover churn drilling from 1953 to 1959, were qualified by Nelson who said that the 27-T footage came almost exclusively from softer drilling wash and heavy media ores; the 29-T footage from leaner ores and intermittent hard rock; and the 42-T from taconite. A performance breakdown for a 42-T drill on a taconite stripping operation in 1957 is given in Table 6. The $2.50-per-ft cost is approximately twice the average for taconite and ore drilling but resulted from severe damage to the gage edges caused by predominant jointing planes in the taconite which were opened up by each preceding blast. The ratio of labor to total drilling cost can be de-

Table 2. Comparison of Churn Drill and Rotary Drill Performance and Costs*

	Churn Drill	6¼-in. Rotary	9-in. Rotary
Ft per shift...	1	5.70	4.90
Cost per ft...	1	0.39	0.50
Cost per ton..	1	0.96	0.59

*Using 1955 churn drill performance as Base (1).

Table 3. Rotary Drill Operating Performance*

	Ft per Shift	Ft per Bit	Bit Cost per Ft	Tons per Ft of Hole†
6¼-in. Rotary	390	1200	7.8¢	46
9-in. Rotary..	343	2350	7.4¢	95

*1st six mo. 1960.
†50-ft bench.

Source: MINING ENGINEERING, January, 1961.

Table 4. Rock Drillability of Mesabi Materials

Material Classification	Drillability Factors
Commercial taconite.....	0.20-0.80
Non-commercial taconite....	0.75-1.50
Rock and ore seams.....	1.50-2.00
Ore with rock seams.....	2.00-2.50
Heavy media ores.....	2.50-3.50
Sandy wash ores.....	3.50-5.00
Wash ores.....	5.00 and up

Table 6. Churn Drill Performance for Taconite Stripping

Drill Data

Time involved	4 months
Material drilled	Dense, fairly massive taconite, lean in iron mineral
Average powder factor	0.90 lb per cu yd
Cu yd per ft of hole	13.5
Total no. of holes	1395
Total footage drilled	44,000
Ft per 8-hr shift	32.6
*Drill availability	66.1%
Ft per drilling hr	6.14
Approximate cost per ft	$2.50
Approximate cost per cu yd	$0.18

Bit Data

Size	9-in.
Average ft per sharpening	18.0
Average sharpening per bit	80
Total footage per bit	1440 ft
Average cost per bit use	$4.88
Average cost per ft	$0.27
Average cost per cu yd	$0.03

*Moving and setting up was counted as delay time for use in comparison with rotary and down-the-hole drills.

Table 5. Churn Drill Performance & Costs, Mesabi Range, 1953-1959

Type of drill	Bit size	Total footage	Ft per drilling hour	Ft per 8-hr shift	Approx. cost per ft
27-T	6-in.	347,000	10.0	64.0	$0.80
29-T	9-in.	420,000	6.0	38.8	0.90
42-T	9-in.	218,000	8.0	40.0	1.00
Total.....		985,000	8.5	48.0	$0.89

Source: QUARTERLY OF THE COLORADO SCHOOL OF MINES, Drilling & Blasting Symposium, Vol. 56, No. 1, Jan. 1961.

Table 7. Rotary and Down-The-Hole Drill Performance and Cost, Mesabi Range

Drilling Method	Rotary				Down-the-Hole					
Drill make	A	B	C		A	B	C	D	E	
Bit size	9-in.	9-in.	9⅞-in.	Total	7½-in.	9-in.	7½-in.	7½-in.	6½-in.	Total
Footage	161,000	74,000	148,000	383,000	42,000	67,000	161,000	27,000	24,000	321,000
Ft/8-hr shift	232	274	206	230	247	244	307	168	174	264
Ft/drilling hr	38.8	55.0	43.5	43.7	52.5	56.2	59.0	29.5	28.2	52.7
% Availability	75.0	62.3	59.1		58.8	54.2	65.0	71.0	75.7	
Drill cost/ft	$0.83	$0.88	$1.17	$0.99	$0.48	$0.83	$0.38	$0.65	$0.24	$0.50
Bit averages:										
Initial cost	$1160	$1134	$1295		$485	$825	$485	$485	$405	
Ft/bit	3600	2700	2216	2891	9000	4645	4850	3230	12,000	5748
Cost/ft*	$0.32	$0.42	$0.58	$0.44	$0.06	$0.20	$0.10	$0.15	$0.03	$0.11

*These figures do not include hammer costs, which add from $0.02 to $0.07 per ft.
Source: QUARTERLY OF THE COLORADO SCHOOL OF MINES, Drilling & Blasting Symposium, Vol. 56, No. 1, Jan. 1961.

LEGEND

A. The two drills in this group are the same make and size—both use electric power, center-mounted mast, and Kelly-type rotary motion. Of all material drilled, 75% was in oxidized seams of alternating ore and rock, and 25% in banded cherty taconite.

B. This represents one drill of electric power design with center-mounted mast and pull-down, threaded chuck, rotary motion. The bulk of drilling with this machine, both rotary and down-the-hole, has been in highly oxidized layers of friable ore and rock.

C. This group is composed of one electric-powered, center-mounted mast-type rotary drill with the same rotation drive as group "B." However, it is an older and heavier machine than "B." It was originally purchased for a property where stripping ratios of taconite volume to ore concentrate tonnage were, and still are, commonly at 3 to 1. Since 1955 this machine has performed in hard, banded, cherty taconite for better than 50% of its footage. Just recently a down-hole modification was effected and the mine operator is enjoying highly satisfactory results.

D. This group consists of two diesel-driven, front-end mast-mounted machines using compressed air as the exclusive driving force for all components. One of the units has drilled high oxidized, decomposed, sandy material, whereas the other one has encountered about 25% hard, consolidated taconite and 75% siliceous cherty ore with intermittent narrow bands of soft, slaty hematites. These drills were purchased primarily for down-hole work.

E. This represents a drill of basically rotary design but used primarily as down-hole. It is diesel-powered and used hydraulically driven rotary motion through a threaded chuck whose vertical motion is effected by sprocket and chain. This drill has operated mostly in bedded ore and rock formations with no excessive amounts of taconite.

F. This is a front-end, mast-mounted machine with diesel-driven rotary compressor. Air activates all the components except leveling jacks. This is not necessarily a typical record, but was included to show the great variation in bit performance in material very similar to that drilled by "D" and "E."

termined from the drilling speed and the fact that it now costs $5.00 per hour, base rate, to crew a drill with operator and helper.

Rotary and down-hole drill performance are summarized in Table 7 with a short description of the drilling conditions under the table. Nelson offered a more detailed picture of one of the machines in Group C for comparison with churn drilling (Table 8). This breakdown was included because the drilling conditions were similar to those presented in Table 5.

In the conclusion of his report, Nelson offered the following, "The concept of rotary in softer material and down-the-hole in the harder formation is slowly being proved somewhat incorrect. The down-the-hole innovation appears to be gaining greater acceptance, not because it out-drills the rotary in all instances, but because of its much more desirable bit costs."

The per-unit cost of drilling equipment can be expected to be lower for large operations than for small operations because the small operator is more limited in the amount of time he can use a given item of equipment. In other words, equipment depreciates by time and not necessarily by usage. On this basis, one drilling expert used the following cost estimates as a guide for down-hole drilling costs:

If a $70,000 down-hole machine drills 2000 hr per yr, and the drilling rate is about 15 ft per hr, with a bit life of 4000 ft, the total cost (including labor, fuel, supplies, maintenance, bits, regrinding, freight, supervision, insurance, amortization, etc.) will be about $2.30 per ft. Increased drilling

Table 8. Down-The-Hole Drill Performance

Drill	
Type	Air-operated down-the-hole
Time involved	6 months
Average powder factor	0.05 lb per cu yd
Cu yd per ft of hole	14
Total no. of holes	4000
Total footage drilled	120,000
Ft per 8-hr shift	251
*Drill availability	67.3%
Ft. per drilling hr	46.6
Approximate cost per ft	$0.50
Approximate cost per cu yd	$0.036
Bit Data	
Size	7½-in.
Average ft per regrind	335
Average regrinds per bit	10.6
Average total footage per bit	3554 (22 bits scrapped in 78,180 ft)
Average cost per bit use	$6.51
Average cost per ft	$0.155
Average cost per cu yd	$0.011

Table 9. Typical Cost Analysis, Well-Drilling (Shallow Hole)

Estimated Cost per Hour at Job Site	Churn Drill	Drill master
Labor: Driller & Helper	$3.45	$3.45
(Self employed)		$3.45
Fuel	.42	1.12
Lube Oil (Engine, Compressor and Drill)	.55	.90
Maintenance Labor and Supplies		2.00
Operating Cost per Hour	$4.42	$10.92
Bit Cost (Including Resharpening)	$ .17	$5.20
Rod Cost		.10
Bit and Rod Cost per Hour	$ .17	$5.30
Insurance	$ .08	$1.00
Amortization of Purchase Price	.82	15.67
Road Expenses	.03	.40
Amortization, Insurance and Travel per Hour	$ .93	$17.07
Total Estimated Cost **Per Hour** (Exclusive of Casing)	$5.52	$33.29
Total Estimated Cost **Per Foot**	$4.80	$3.32
Feet per hour overall	1.15 ft	10 ft
Bit Size	6-in.	6-in.

Table 10. Typical Cost Analysis, Well-Drilling (Deep Hole)

Estimated Cost per Hour at Job Site	Churn Drill	Drill-master
Labor: Driller	$1.75	$2.25
Helper	1.50	2.00
Fuel	.60	1.12
Lube Oil (Engine, Compressor and Drill)		.90
Maintenance Labor and Supplies	.50	1.50
Service Truck		2.00
Operating Cost per Hour	$4.35	$9.77
Bit Cost (Including Resharpening)	$ .68	$1.95
Rod Cost		.20
Bit and Rod Cost per Hour	$ .68	$2.15
Insurance	$ .24	$1.50
Amortization of Purchase Price	2.50	16.62
Road Expenses	.03	.10
Amortization, Insurance and Travel, per Hour	$2.77	$18.22
Total Estimated Cost **Per Hour** (Exclusive of Casing)	$7.80	$30.14
Total Estimated Cost **Per Foot**	$3.90	$2.01
Feet per hour overall	2 ft	15 ft
Bit Size	6-in.	6-in.

rates and usage will lower the cost at a slightly non-linear proportional rate.

Tables 9 and 10, for example, illustrate what drilling can cost on a small job. However, these tables from a leading manufacturer also show what churn drilling costs on the same job. Table 11 is a cost-estimating summary sheet that can be used to compare different drilling methods.

Jet Piercing

Jet piercing speed, unlike other types of drilling, is related to spallability rather than drillability of rock. Rocks that spall satisfactorily are taconite, specular hematite, syenite, gneiss, quartzite, granite, sandstone and dolomite. Aside from the fixed costs of owning and operating, the variable costs are directly related to fuel consumption and drilling speed. Since fuel consumption is usually fixed, the cost-per-ft is directly proportional to drilling speed. Table 12, from last month's article on jet pierc-

Table II. Cost Estimating Comparison Sheet

ESTIMATED OPERATING COST/HOUR @ MINE SITE	TYPE OF DRILL			
1. LABOR: DRILLER				
2. HELPER				
3. FUEL:___GAL/HR @ $0.__/GAL				
4. ENGINE LUBE				
5. COMPRESSOR LUBE				
6. DRILL LUBE				
7. MAINTENANCE LABOR & SUPPLIES				
8. (CABLE)				
9. EST. OPER. COST/HR LESS BITS, RODS, SUPERVISION AND AMORTIZATION (Total item 1 thru item 8)				
10. BIT SIZE				
11. BIT COST				
12. FREIGHT				
13. BIT COST @ MINE SITE (Item 11 + Item 12)				
14. EST. BIT LIFE				
15. RECONDITIONING COST/LIFE OF BIT				
16. TOT. EST. BIT COST (Item 13 + Item 15)				
17. EST. BIT COST/FT (Item 16 ÷ Item 14)				
18. EST. OVERALL DRILLING SPEED (Ft/-Hr)				
19. EST. BIT COST/HR (Item 17 × Item 18)				
20. EST. ROD COST/FT				
21. EST. ROD COST/HR (Item 20 + Item 18)				
22. (EST. WATER AND BIT TRANSPORTATION/HR)				
23. EST. TOT. OPER. COST/HR LESS SUPERVISION AND AMORTIZATION (Item 9 + Item 19 + Item 21 + Item 22)				
24. SUPERVISION				
25. AMORTIZATION				
26. EST. TOT. OPER. COST/HR (Item 23 + Item 24 + Item 25)				
27. DEPTH				
28. TOTAL EST. DRILLING TIME (Item 27 ÷ Item 18)				
29. TOTAL EST. DRILLING COST (Item 28 × Item 26)				

Table 12. Jet Piercing Drilling Rates

Rock or Iron Formation	Jet Piercing Speed, fph
Oxidized and altered taconite,.	14
Lower cherty magnetic taconite, Area A	25
Lower cherty magnetic taconite, Area B	12
Upper cherty magnetic taconite, Area C	23
Lower slaty taconite	11–12
Michigan quartzite	30
Michigan jasper (magnetite specularite)	19–40
Labrador specularite	23–40
Michigan conglomerate	20
Michigan diorite	12
Michigan sericitic dike	9
Michigan argillaceous iron formation	14
Arkansas syenite	18
Massachusetts granite	20
Potsdam sandstone (St. Lawrence Seaway)	20

Table 14. Data on Jet Piercing at St. Lawrence Seaway Project

	(Canadian $)
Hourly cost of machine	$76.09
Cost per foot drilled—includes ownership and all operating costs	$2.54
Drill pattern	20 ft × 20 ft
Net cost per cu yd	$0.35
Net cu yd drilled per hour	220 yd
Net cost to drill 1,000 cu yd	$350.00
Time required to drill 1,000 cu yd	4½ hours

Source: United Waterways Constructors Ltd. in MINE & QUARRY ENGINEERING, Oct. 1960.

Table 13. Cost Analysis of Various Types of Drill

	Wagon drills	Well drills	Quarry-master type drill
Hourly cost per machine	$ 19.58	$ 9.44	$ 45.57
Cost per ft of drilling	$ 0.98	$ 5.65	$ 6.30
Drill pattern	6 ft × 6 ft	21 ft × 21 ft	13 ft × 13 ft
Net cost per cu yd	$ 0.733	$ 0.346	$ 1.01
Net yards drilled per hr	24 yd	20 yd	60 yd
Net cost to drill 1000 cu yd	$800.00	$480.00	$710.00
Quantity rock required daily	400 bank yd hourly		
Time required to drill approx. 1000 cu yd	41 hours	50 hours	16½ hours
No. of drills required to meet production	18	20	>6

Source: United Waterways Constructors Ltd. in MINE & QUARRY ENGINEERING, Oct. 1960.

Table 15. Jet Piercing Drill Patterns and Chambering Practice

Approximate hole spacing	Ft of chamber	Height of bench	Total depth of holes	Tons per ft of hole
18 × 18 ft	None	25	29	31
20 × 20 ft	4	30	39	38
21 × 21 ft	6	35	39	42
22 × 22 ft	8	40	44	46

Chambering data:

Average chambered hole size	13 in.
Average chambering time per hole	21 min
Average total length of chamber burned per hole	6.5 ft

Source: Cleveland Cliffs Iron Co. in MINE & QUARRY ENGINEERING, Oct. 1960.

ing in E&MJ, shows drilling rates in various materials.

L. Walter in MINE & QUARRY ENGINEERING, October 1960, listed the following six factors to be evaluated for comparing jet piercing with other methods:

1. To determine whether or not the material is amenable to spalling, laboratory and field tests must be made before any investment can be considered. It is believed that over a long period the method will average one-third of the production indicated under ideal laboratory conditions. This figure should be used in computing costs.

2. Costs should be computed for the following materials as delivered to the drill site: kerosene; water in a pure state; electrical power; and oxygen supply, including royalty payments to the patent holders, Linde Air Products Co. (Payment is based on the amount of fuel used and not on oxygen consumed.)

3. It can be assumed that labor costs will be similar to those for other types of drilling, both in amount and in rates.

4. Maintenance costs will consist of replacing hose, blowpipes, and the usual churn drill parts. These should be about 10% of other direct costs and are not considered excessive.

5. Capital investment is low if the cost of the drill to be converted is not considered. Generally the cost of oxygen storage is assumed by the supplier. With these conditions, capital investment should be 20% of the cost of drilling equipment for any comparable method.

6. In many cases, there are excellent reasons for being able to change the size of the blasthole at any desired depth. The economic value of this procedure must be given full consideration.

United Waterways Constructors Ltd. reported its cost analysis of various drilling methods for its portion of the St Lawrence Seaway Project. United used a piercer that consumed 10,000 cu ft of oxygen and 40 gal of fuel oil per hr. These data are given in Tables 13 and 14. The main contractor, Angus Robertson Ltd., encountered certain "teething troubles" with piercers on its portion of the project.

Tables 13 and 14 show a low cost per cu yd for well drills (34.6¢ as compared to 35¢ for jet piercers), but a much larger production rate for

Table 16. Primary Blasting Costs, Copper Mine

Period	Total Money	Total Material Broken (¢ Ton)	Cost/lb of Explosive Used	Tons Broken Per Lb of Explosives	Lb of Explosives Used
2nd six months of 1954	$104,629	2.14¢	14.60¢	7.41	659,100
1955	172,074	2.03¢	15.13¢	8.00	1,055,500
1956	134,117	1.87¢	12.27¢	7.23	993,000
1st six months of 1957	40,333	1.24¢	7.47¢	7.50	437,200

Table 17. Primary Blasting Data (Nevada Mines Div., Kennecott Copper Corp.)

	65% Bag Powder	Akremite Type	Ammonium Nitrate
Blasting Efficiency			
Tons Blasted per Lb Explosive.	6.73	5.64	4.81
Lb Explosive per Ton Blasted..	0.15	0.18	0.21
Blasting Cost per Ton			
Primary Explosive....	$0.024	$0.013	$0.008
Diesel Fuel....			0.001
Primer.....	0.001	0.003	0.002
Primacord-caps-fuse.....	0.002	0.002	0.002
Labor.....	0.008	0.008	0.003
Total.....	$0.035	$0.026	$0.016

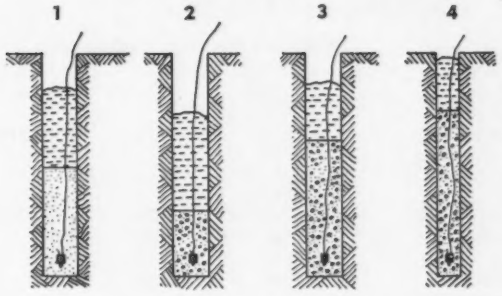
Source: MINING CONGRESS JOURNAL, May, 1959.

Table 18. Comparison of Costs at Iron Ore Co. of Canada

	100 lb units
Nitrone.....	$17.80
Nitrox.....	19.45
60% Gel.....	24.85
60% Ammonia.....	19.25
Slurry (commercial).....	17.36
Slurry (do-it-yourself).....	7.70
AN/Fuel (94:6)(do-it-yourself)	5.00

Source: THE CANADIAN MINING AND METALLURGICAL BULLETIN for October, 1960.

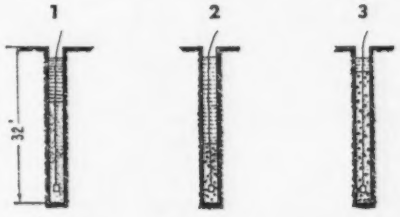
Table 19. Blasting Costs by Method, Iron Ore Co.



powder factor: 1.5 lb per yard or .65 lb per ton

Explosive	Depth (ft)	Spacing (ft)	Hole dia (in.)	Powder Col. (ft)	Powder Cost/yd	Drilling cu yd	Broken Rock Cost
1. AN and fuel....	40	15 × 15	10	18.5	6.75	55.2	61.95
2. Slurry..	40	15 × 15	10	10.6	11.6	55.2	66.8
3. Slurry..	40	21 × 23	10	22.8	11.6	25.7	37.3
4. Slurry..	40	16 × 16	6	28.4	11.6	—	—

Table 20. Blasting Costs by Method, Iron Ore Co.



powder factor: .7 lb per yard or .4 lb per ton

Explosive	Depth (ft)	Spacing (ft)	Hole dia (in.)	Powder Col. (ft)	Powder Cost/yd	Drilling cu yd	Broken Rock Cost
1. AN and fuel....	32	8 × 8	3	21	3.1	26.7	29.8
2. Slurry..	32	8 × 8	3	12	5.2	26.7	31.9
3. Slurry..	32	12 × 12	3	27	5.2	12.1	17.3

jet piercing (220 cu yd per hour as compared to 20 cu yd per hour for the well drill). Table 15 is a summary of performance data from Cleveland Cliffs Iron Co. for its iron mines.

Blasting

Since E&MJ first reported practical use of carbonaceous AN mixtures in May 1955, usage has become widespread. Today, most pits blast with AN in one form or another.

Table 16 shows how one mining company reduced its blasting costs after switching to AN. The 1957 explosive cost per blast hole (9-in.-dia, 60-ft deep), which included diesel fuel, primer and AN, but did not include Primacord and millisecond delays, was approximately $8.25. This compared with a cost of approximately $25.00 per blast hole when 40% and 60% dynamite was used exclusively. Thus AN saved $16.75 per hole. During the first six months of 1957 all blasting was done with AN prills. AN costs have since been lowered below the 1957 figure.

Kennecott's Nevada Mines Div. experienced the same relative cost-savings with AN/fuel oil that most mining companies experienced. As shown in Table 17, primary explosive cost of the AN (0.8¢ per ton of rock), was one-third that of 65% strength powder (2.4¢ per ton of rock), and total blasting cost was reduced to less than half by changing to AN (1.6¢ as compared to 3.5¢).

Frank Quilici, pit superintendent, who reported the costs in MINING CONGRESS JOURNAL, May 1959, explained that the cost differences in other items in the table were due to changes in drilling and blasting practice.

Bulk-handling has reduced AN costs even further. John Ryon in E&MJ, August 1960, reported that International Salt Co. paid about 3½¢ per lb for prilled AN in bulk shipments. This compared to 18¢ to 20¢ per lb for straight dynamite.

Recently published data on carbonaceous AN mixtures are numerous, corresponding to a wide variety of AN types and mixtures available. Explosive force and sensitivity are the parameters controlled by varying procedures. Maximum force is apparently obtained by high density mixtures containing 5.5% fuel oil while maximum sensitivity is achieved with a lower proportion of fuel-oil and finer grained AN. The problem is to achieve a sensitive, but not too sensitive, mix while achieving maximum force.

Sensitivity and water-compatability are two problems of AN which led to the development of blasting slurries (principally AN, TNT and water). The slurries, although more expensive than AN/FO, generally give a

Table 21. Comparison of Cost by Explosive, Iron Ore Co.

	Hydromex AN/FO	Hydromex
Blasthole pattern	18 × 21 ft	21 × 29 ft
Blasthole depth	35 ft	35 ft
Subgrade drilling	4 ft	4 ft
No of holes required	33	24
Total drill footage	1155 fs	840
Cu yd broken	16,190	18,990
Cu yd yield	14,320	16,800
Total Charge weight	24,700 lb	22,320 lb
Loading factor	1.52 lb/cu yd	1.18 lb/cu yd
Yield factor	1.72 lb/cu yd	1.32 lb/cu yd
Explosive cost	$3055.00	$4065.00
Drilling cost		
(a) R. G. 2J Bits	$2250.00	$1142.00
(b) Labor	$316.00	$230.00
(In each case cubic yards yield was used to compute unit cost)		
Explosive cost cu yd	21¢	24¢
Drilling cost cu yd		
(a) Labor	2¢	1¢
(b) Bits	16¢	7¢
Total cost/cu yd	39¢	32¢
Cu yd/ft blasthole	12.4	20
Cu yd available/24 hours	5140 cu yd	8280 cu yd
(Assuming drill operating hours are 75% of scheduled hours)		

Assumptions made in the calculation are as follows:

(a) Hydromex $18.25/100 lb

(b) AN-FO $6.50/100 lb

(c) Drilling available footage/RG2J bit:
Case (a) 769 ft
Case (b) 1100 ft
Cost/RG2J bit = $1,500.00
Labor Costs = $4.72/scheduled hour
Penetration Rate = 23.0 ft/operating hour

(d) Load factor—pounds explosive/cu yd material broken.

(e) Yield factor—pounds explosive/cu yd available material.

The net result shows a reduction in drilling and blasting costs of $0.07 per cubic yard of material broken, plus an increase of 3140 cu yd made available per 24 hr. Eliminating the effect of increased bit life, the overall reduction in cost was $0.02/cu yd.

greater tonnage of broken rock per lb and are water compatible. Many companies, however, get around the water problem by bagging the AN/FO in water-proof containers, although this adds to blasting costs.

Detonation pressure of slurries is about three times as high as that for AN/FO, and explains why they can be considered more economical in areas where drilling costs are high. The Iron Ore Co. of Canada, for example, spends $4.60 per ft of 10-in. borehole for drilling in hard rock which makes it imperative that they get as much blasted rock as possible per ft of borehole.

H. E. Farnam, Jr., who reported the costs in THE CANADIAN MINING AND METALLURGICAL BULLETIN for October 1960, also explained that operating cost per hour for a 50-R rotary drill was $37.00 with a speed of 20 ft per hr and a bit life of 600 ft. Tables 18, 19 and 20 (all from Farnam's article) show cost and performance data for various explosives.

Farnam also wrote about slurries for small hole application: "By increasing the TNT content to 35%, the slurry can be detonated in holes down to 1½-in. in diameter. The cost of this slurry would increase from $7.70 per hundred to $11.00 per hundred.

"Another slurry mixture that will successfully detonate in 1½-in. holes is a 30/30/30/10 mixture of AN, sodium nitrate, TNT and water. This mixture costs $10.30 per hundred lb." Sodium nitrate lowers the freezing point to minus 10° F and increases the density from 1.4 to 1.7.

An example of how higher cost explosives can decrease blasting costs in hard rock was given by D. J. Selleck at the February 1961 International Symposium on Mining Research. Selleck experimented with a 50-50 Hydromex (slurry)-AN/FO mix then in use at the Iron Ore Co. and compared it to straight Hydromex. Cost and performance results are given in Table 21.

On the other hand, a paper by Ulf Langefors (head, Physical Research Laboratory, Nitroglycerin Aktiebolaget, Sweden) stressed the lower over-all cost of AN/FO over slurries in Sweden.

Langefors analyzed cost and performance for various methods of loading holes: (1) AN/FO or Ammonit (pre-mix) only, (2) various dynamite bottom charges and Ammonit or AN/FO column charge, (3) dynamite only, (4) slurry only, and (5) slurry bottom charge and Ammonit or AN/FO column charge. He listed the costs as follows (including freight, storage, transportation and mixing): Dynamite, $0.50/kg; Ammonit, $0.20/kg; AN/FO, $0.13/kg; AN-TNT-slurry, $0.20/kg; and Nabit (pre-mix), $0.38/kg.

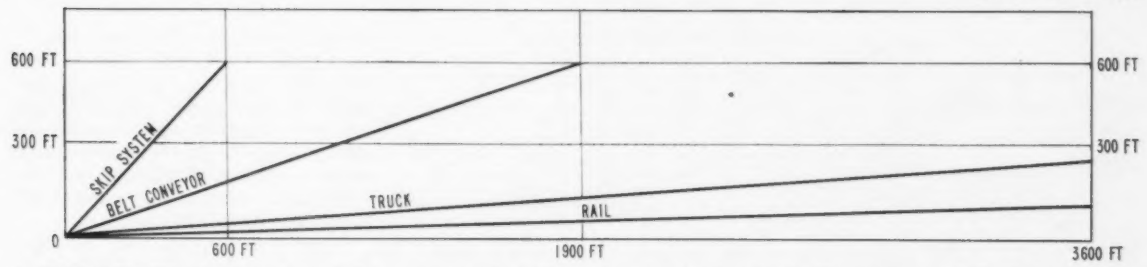
Factors analyzed by Langefors were (1) amount of rock broken per explosive unit explosive, (2) structure of the ammonium nitrate (crystalline vs prills), (3) influence of hole diameter in total cost, (4) influence of different drilling costs on total cost, and (7) loading costs.

Results of Langefors analysis showed lowest over-all costs for crystalline AN/FO column charge and a dynamite bottom charge. When drilling costs were high, an increase in the amount of dynamite in the bottom charge gave the lowest rock-breaking cost. These combinations also gave 50% more broken rock per hole than could be obtained from straight dynamite and 20% more broken rock than slurries. This analysis presupposed a drill hole not exceeding 100 mm (about 4 in.) in diameter.

It May Pay to Increase Cost

Langefors, like many operators, is cognizant of the over-all mining cost reduction that may be obtained by increasing the rock-breaking cost. (This savings would show up in loading, hauling and crushing.) He expressed this as follows:

"The analysis of costs made here does not include the fact that with smaller burden a better fragmentation and thus also lower costs for loading and for machine repair and maintenance equipment are obtained. The cost for loading the broken material is about the same as the minimum blasting costs, and it is evident that if the costs for drilling and blasting together are about the same, in a choice between two cases with different burdens, the final decision will depend on the cost for the digging and thus favor smaller diameter. This means that in practice it would be advisable to use diameters not exactly up to the computed minimum but to choose smaller values. With the low cost for the explosive we can also consider using more explosive per cu m; in those cases this can be expected to give a better fragmentation."



A COMPARISON of the horizontal distance required to lift material a given number of feet shows why skips are suited to pits requiring short hauls. The money saved by eliminating overburden removal for other methods may pay for the equipment.

Deep Pit Skip Costs

IN THE TRANSPORTATION INDUSTRY, haulage costs are generally given on a ton-mile basis. In mining however, the ton-mile cost is not an accurate guide because the primary consideration is elevating the ore from the pit—the mill is usually close-by.

Although the topographies of many mines favor low-inclined, long hauls, there are pits particularly suited for steep-grade skip haulage. The grade range of skips compared to other transportation methods is shown above.

Recent examples of pits using or installing skip systems include Pima (E&MJ, March 1958, p 98), Liberty (E&MJ, May 1960, p 105) and Chino (E&MJ, June 1960, p 322).

Operational data are given in the articles referred to.

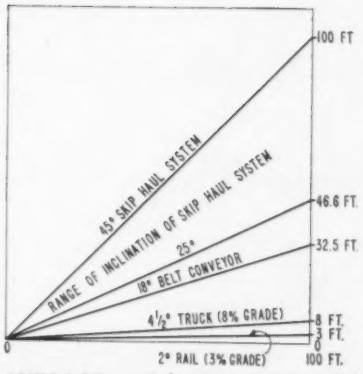
Pima Mining Co., which based its decision to install a skip on successful installations in the iron country, reported its haulage costs for the first half of 1958 in MINING CONGRESS JOURNAL, March 1959. At that time the following breakdown was given:

Skip	5.65¢ per ton
Trucks, 802's in pit	9.71¢ per ton
Trucks, 802B's on surface	5.09¢ per ton
Total	20.45¢ per ton

The 20.45¢ was higher than Pima's original estimate, but still well below its 24¢ per ton estimate for straight truck haulage. Further, the writer, E. D. Spaulding, resident manager of Pima, expected the costs to drop with operational experience.

Pima was well-suited to a skip installation because of its narrow, steeply-dipping orebody.

National Iron Co. advertises load capacities for its Rockover skip systems of 15- to 50 tons. Operational capacity varies correspondently, and is about 1000 tph for the 25-ton skip system at Liberty.



AVERAGE maximum recommended slopes show skips highest.

A primary feature of skips is that they keep the stripping ratio low in deep, narrow orebodies. Pima estimated its stripping savings at $1,710,000 (based on an additional 3,200,000 yd of material that would have to be removed for a straight truck system). This savings amounted to $366,000 less than the capital investment of $1,244,000 that was required for the complete skip-truck system (two skips, ten 22-ton trucks and four 50-ton trucks). Thus, in a sense, the equipment was paid for before it started operation.

Skip costs run from about 2¢ to 6¢ per ton for lifting from a pit. Pima, for example, charged about 5½¢ per ton to the skips for a 280-ft lift in the first half of 1958.

How to Compute Skip Costs

The following calculations show how a skip vs truck-haulage system can be computed. These were preliminary estimates given several years ago from an undisclosed mine, and do not reflect the mine's present status. The following cost estimates include labor (operating and repair) and fuel. Depreciation is not included.

Estimated Operating Cost

1. Complete truck haulage (7000 tons/shift) 22 trucks, 22-ton capacity @ $7.35/hr.
   $\frac{735 \times 22 \times 8}{7000}$ ..... 18.48¢/ton
2. Skip hoist system & trucks (7000 tons/shift)
   Hoist power $24/shift
   $\frac{2400}{7000}$ ..... .34
   Hoist labor:

2 hoist men	$43.64
2 skip men	33.50
2 feeder men	33.50
	$110.64

   $\frac{11{,}064}{14{,}000}$ ..... .79
   Hoist maintenance ..... .80
   Total Hoist 1.93¢
   7 trucks, 22-ton capacity @ $7.35/hr
   $\frac{7 \times 735 \times 8}{7000}$ 5.87
   4 trucks, 50-ton capacity @ $7.82/hr
   $\frac{782 \times 4 \times 8}{7000}$ ..... 3.58¢
   Total 11.38¢/ton

Operating cost savings of skip hoist system over complete trucking would thus be estimated at 7.1¢ per ton. However, capital investment must be taken into consideration.

Capital Investment Comparison

1. Complete Trucking
   22 trucks required, 22-ton capacity
   22 x $36,500 ..... $803,000
2. Skip System & Trucks
   7 trucks required, 22-ton capacity
   7 x $36,500 ... $255,500
   4 trucks required, 50-ton capacity
   4 x $48,000 ... 192,000
   1 Skip System complete ... 537,000
   Total $984,500

The skip system would require $181,500 initial outlay over a complete trucking operation. However, the savings in operating costs would balance this in a relatively short time. The estimated daily saving with the skip hoist system would be $944.

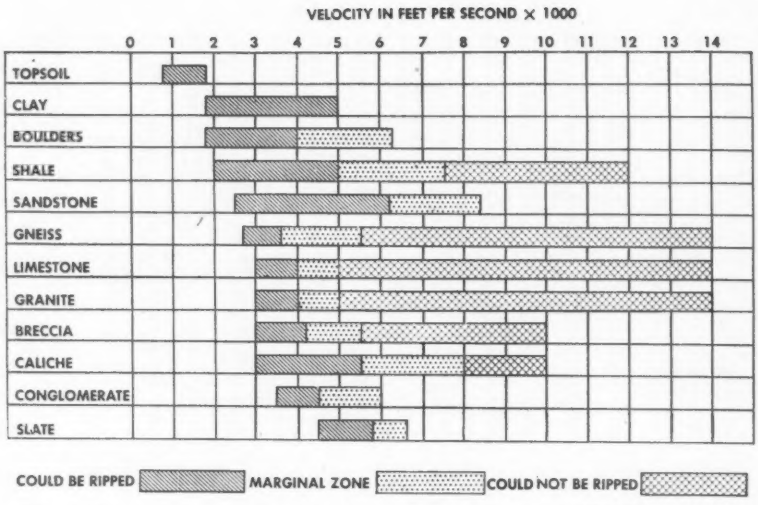


FIG. 1 Material transmitting seismic waves at velocities up to 8000 ft per second can be ripped. The above chart was designed for a ripper on a Cat D-9 tractor.

Is Ripping Cheaper Than Drilling & Blasting?

RIPPING COSTS start at 3¢ to 4¢ per yd and are usually under a dime. Ripping is a more important economy for operators whose drilling and blasting costs are high (see the Guidebook section on Drilling and Blasting) than for those whose costs are down around ripper's level. There may be added indirect benefits to choosing this method, however, in that the broken material is usually finer, and therefore eligible for low-cost scraper loading and hauling.

Ripping, as a mining method, has recently been put into practice at the Bingham Pit (E&MJ, August 1960, p. 85) and the Jackpile Mine. At Bingham, Morrison-Knudsen based its low bid for KCC's drop cut on the belief (1) that the Bingham pit could be ripped, and (2) that it could be mined more cheaply by ripping than by drilling and blasting. Anaconda chose a ripper for the Jackpile mine to clean up ore pods in the bottom of the pit.

Not all material can be ripped. However, the range of rippable material has been greatly extended by the introduction of tougher, longer lasting steels for rippers; heavier, more powerful tractors; and by the technique of ripping in tandem. Tandem ripping has proved cheaper than single tractor ripping in some instances because of the increased productivity.

With the introduction of the electric-wheel scraper, it was suggested in E&MJ, January 1961, that the ripper-electric wheel combination be investigated for pit use. Increased use of ripping in mining will depend, however, on extending the range of rippable material and, where ripping can now be used, on balancing the cost-savings, if any, with the capital expense required to change methods —especially if present equipment has been amortized.

Originally, ripping was used for loosening hardpan in earth-moving operations. Since its introduction, the technique has been extended to other types of construction activity, to rock quarries, and finally to medium-hard rock mining.

Presently available cost data comes mostly from construction projects and rock quarries. Costs vary directly with the hardness of the material but so too, do drilling and blasting costs. Much of the cost data, case histories, and tables in this section were made available through the courtesy of Caterpillar Tractor Co.

An examination of the job reports in this section illustrate two important points: (1) The relatively high cost of drilling and blasting for the small- and medium-size operator, and (2) the wide variation in cost.

These reports give direct costs of ripping vs drilling and blasting for breaking the material only. The indirect costs (those at the hauler, loader and crusher) are not accounted for. Consequently, cost analysis of ripping would have to include a systems analysis of operations.

The present status of ripping vs rock type is illustrated in Fig. 1 and 2. Fig. 1 shows the range of rippable material vs shock wave velocity (See E&MJ, June 1960, "Using Seismics to Determine Rippability"). Fig 2 shows the relative range of different ripping methods.

According to Caterpillar, ripping for scraper loading is generally profitable when ripper production exceeds 150 to 200 broken cu yd per hr. At this production rate, the cost of ripping may be less than that of blasting powder alone on construction jobs. Grid rollers are sometimes used to crush

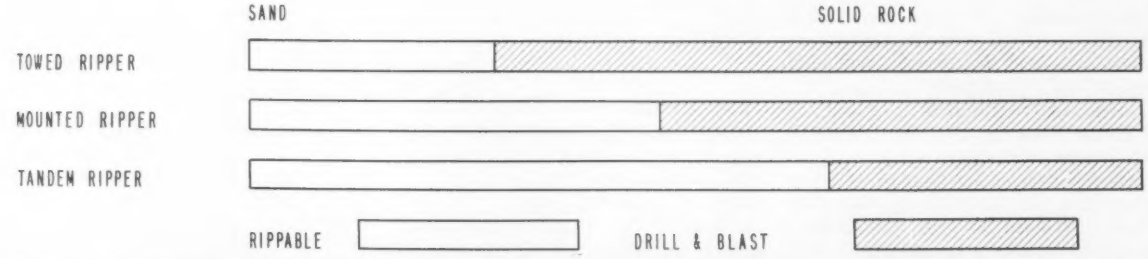


FIG. 2 The evolution of ripping methods has resulted in a greater range of rock eligible for the method. The above chart illustrates the comparative range for each of three methods. Tandem ripping may be cheaper because of increased output.

Job Report 1

Location: Alpena, Mich.
Description: Quarry for cement plant.
Material: Shale. Density—167 lb per cu ft.
Equipment: D9 Tractor with 9S Dozer and No. 9 Ripper with two straight shanks.
Technique: Rips parallel to highwall face, average one ft deep at 12 ft pass spacing. Average ripping speed— 1.7 mph. Dozed ripped shale over highwall to shovel; dozed opposite direction when face was too low.
Production: 4 to 500 tph ripping.
540 tph dozing average distance of 100 ft.
O & O Cost*: $20.87 per hr.
Cost per Ton: Ripping—0.46¢.
Dozing —3.86¢.
Total 4.32¢.
Comments: High hourly production and expected long life of undercarriage components result in extremely low cost per ton of quarried material.

*O & O is Owning and Operating.

Job Report 2

Location: Elmhurst, Ill.
Description: Rock quarry.
Material: Dolomitic limestone used for aggregate, in heavily bedded layers four in. to three ft thick. Density—4850 lb per BCY.
Equipment: D9 TC Tractor with Kelley Ripper and 9S tilt dozer.
Technique: Ripper used to pry under and lift large slabs of rock which were crushed under tracks on back-up or next pass. Material dozed to pile for shovel.

	"Easy" Ripping:	Tandem Ripping:
Production:	560 BCY/hr	340 BCY/hr
O & O Cost:	$30.00/hr.	$74.00/hr
Cost per BCY:	5.35¢	21.8¢

Comments: Single D9 ripped rock on one side of quarry. Tighter, more heavily bedded rock on other side required tandem ripping.
O & O costs included $6.00 and $26.00 per hr for ripper tips for single and tandem ripping respectively. Even at this rate, ripping was cheaper than blasting. Use of a different tip extended life to over ten hours on the tandem ripping operation. Powder costs alone, in this quarry, averaged 66¢ per BCY.
Ripping was initiated in this quarry because of blasting difficulties resulting from proximity of residential area. Ripping was continued because of lower costs and higher plant production.

Job Report 3

Location: Novato, Calif.
Description: Quarry furnishing rock for aggregate.
Material: Basalt, in one- to eight-in. layers bedded 35° to horizontal.
Equipment: D9 DD Tractors (2) both with rear-mounted rippers; one with 9U, one with 9S dozer.
Technique: Ripping with two straight shanks generally done simultaneously with dozing average of 400 ft to stockpile. Some hard knobs required separate attention.
Production: 300 to 400 BCY per hr ripped and dozed to the stockpile.
O & O Cost: Not determined.
Comments: Two D9s with rippers took over entire quarry operations: stripping overburden, ripping, dozing to stockpile, dozing to crusher, building roads, and other miscellaneous jobs.

Job Report 4

Location: Fairborn, Ohio.
Description: Rock quarry.
Material: Limestone used for cement making, irregular laminations, moderate consolidation.
Equipment: D9 DD Tractor with No. 9 Ripper and 9S tilt dozer. One to three straight shanks used on ripper.
Technique: Ripped in 200-ft passes, average of one ft in depth on first pass. Cross-ripped to break up large slabs and hard knobs of rock. Dozed over highwall and into pile for shovel loading.
Production: Average 350 BCY per hr ripping and dozing.
O & O Costs: $35.00. /hr.
Cost per BCY: 10¢.
Comments: Cross-ripping and crushing under the tracks produced finer material than formerly obtained with blasting.
O & O costs were figured very conservatively, using 300% depreciation for repairs. This estimate undoubtedly is high, but cost per yd still is low.

Selected Ripping Costs

Location	Material	Ripping Production (CY/Hr)	Ripping Cost (Cents/CY)	Drilling and Blasting Cost (Cents/CY)
Tulsa, Okla.	Limestone	250	7.3	17.3
Dallas, Tex.	"	350	5.2	15.1
San Francisco, Calif.	Sandstone	400	15.0	30.0
Merriam, Kans.	"	1000	2.1	11.7
Nelsonville, Ohio	"	333	5.7	13.8
Chicago, Ill.	Limestone	460	6.5	—
Philadelphia, Pa.	"	196	11.5	19.3
Carbo, Va.	Sandstone	300	8.6	15.7
Hibbing, Minn.	Frozen ground	90	30.0	60.0
Hibbing, Minn.	Paint Rock	350	6.1	54.5

the ripped rock, thus facilitating scraper loading. Ripping for dozing to waste, or over a bench face to a shovel may also pay.

Tandem ripping, using a hydraulic dozer on the push tractor, can be economical even when owning and operating costs are as high as $75 per hr. This cost shows up mainly in undercarriage and ripper tip repair and replacement. Owning and operating costs are calculated using an 8000 hr life and repairs as 100% of depreciation.

As would be expected, the cost per yd of ripped material varies inversely with the production obtained. Thus, for a machine cost of $23.89 per hr and an hourly production of 800 cu yd, the unit cost is about 3.0¢. On the other hand, in the extremely difficult ripping conditions found in frozen ground on the Mesabi Iron Range near Hibbing, the average hourly production was 90 cu yd. Machine cost under these difficult conditions was over $27 for a unit cost of 30¢ per cu yd.

ONE WAY to reduce truck haulage cost is to reduce the dead weight and increase the load capacity. Oliver Mining Co. got five more tons capacity by using T-1 steel.

High Cost of Haulage Is A Major Mine Problem

COST VARIATIONS for drilling and blasting and loading generally amount to only a few cents per ton. Preceding sections of the Guidebook have shown many pit's combined costs for these items to be less than 5¢ per ton. Haulage, on the other hand, not only accounts for the major portion of direct mining costs, but it also is the most variable item. Haulage in effect determines whether or not the total direct cost will be high or low.

The major haulage systems are rail, conveyor, truck and scraper. Skips and pipelines are additional, but limited, systems. Costs vary according to distance: in general, rail is cheapest for very long hauls, conveyors for long hauls, trucks for short hauls and scrapers for very short hauls. The size of the operation affects the length of haul—a pit only a few miles from the mill might have fifty or more miles of track within the pit and thus be suited for rail transportation.

Not only are several transportation systems available, but there are many variations within each system. Increasing the size of locomotives at Chuquicamata, for example, allowed the mine to be worked to greater depth with the rail system. For trucks, there is a wide variety of models available, both in size and powering method (diesel, gasoline, gas-turbine, diesel-electric and electric). Conveyor design is likewise variable; some variations include power, support structures, belt material, degree of troughing, tensioning systems, center-distances, etc. Thus, methods comparisons are valid only for specifically defined systems and costs can be so close that improvements in one or the other may change the economic picture entirely.

Experience of Oliver Mining Co. shows lowest cost with rail transportation. W. N. Matheson, Jr., vice president of operations, writing in MINING ENGINEERING, April 1959, made the following observation: "Comparing the 8% limiting grades of a truck operation with the restrictive ruling grade of 3% for the locomotives, it is readily apparent that a locomotive must travel about three times as fast to get out of the mine. In spite of this increased haulage distance, experience at Oliver indicates that a mine locomotive with its string of from five to ten 30 or 40-cu-yd side-dump cars will transport either ore or stripping material at lower costs than our most efficient mine trucks.

"To show how operating costs compare, the average haulage distance of our diesel-electric locomotive is presently 4.3 miles as against 0.78 miles for trucks. The average haulage elevation is 271 ft for the locomotive as against 144 ft for trucks. Despite these differences, our locomotive haulage costs are about 8% below those for trucks."

Trucks or Scrapers?

E. C. Moss, speaking during a panel discussion on uranium stripping methods before the Third Annual Wyoming Mining Association Convention, April 1958, gave cost comparison figures of truck and scraper operations.

"The choice of open pit excavating equipment for a majority of operations will be a choice of one or two general groups. The two groups are (1) shovel-truck operations with necessary auxiliary equipment and (2) a cat and scraper operation.

"First, let us consider the waste moving phase of an open pit operation. Because it is easier to visualize an actual example, I have chosen a pit with size, length of haul, and with quantities that indicate that if moved by shovel and truck will require a 2½-yd shovel and four 22-ton off-highway trucks or a comparable scraper spread. The following is a breakdown of capital costs for mobile equipment that would be used. (These costs would include freight.): One 2½-cu yd diesel shovel, $80,000; four 22-ton diesel trucks, $188,000; one tractor with dozer, $39,000; one motor grader, $22,000; auxiliary equipment should include a small water truck, a portable welder, a winch truck with flat bed, two pickups and a light plant, $25,000; which gives us a total of $354,000.

"The production from common material, that is any unconsolidated soil, sand or gravel, should be around 250 to 275 cu yd per hr in good digging.

"Working under comparable condi-

tions, it would take the following scraper equipment to get approximately the same production: Three 18- to 20-cu yd scrapers, $150,000; one push cat, $50,000; one tractor for pit and dump maintenance, $39,000; one motor grader, $22,000; Auxiliary equipment, $25,000; which gives us a total of $286,000.

"The capital investment of the scraper operation is about 80% of the shovel-truck equipment, but both groups would probably be depreciated at about 11- to 15¢ per yard, depending on production rate and policy on equipment replacement.

"Depreciation is used here in a sense of reserve for equipment replacement and not as allowed by law for tax purposes. If we assume we have ideal conditions for scraper performance, we should move this material for about 55- to 60% of the cost of a shovel-truck operation. As conditions change, these cost curves will converge. For example, rocky material would affect scraper production much more than it would affect shovel production. If conditions were severe enough there would be no question as the scrapers would not be able to do the job.

"If a comparison were made on hard sandy ground, a ripper cat and more power would be required to load the scraper; at the same time, shovel production would also be affected.

"Finally, if the material were too hard to rip, and drilling and blasting were necessary, scrapers probably would not be practical. Drilling and blasting would increase costs from 10- to 35¢ per yd, and this is quite a spread in cost, but conditions vary so widely that these extremes often occur within one mining operation. Capital costs for a drill for this production would run from $30,000.00 to $70,000.00. The most widely used methods are rotary drilling with tri-cone rotary bits or percussion drilling with wagon drills, or the newly developed down-the-hole drill which is coming into use more and more. . . .

Table 1. Costs of Five Stripping Methods, Demarara Bauxite Co. Ltd.

Method	Cost per cu yd, ¢	Cu yd per hr per unit	Period	Distribution				
				Supplies*	Labor**	Repair & Main.	Depreciation	Total
Shovel and Wagon.	45.9	43.0	1953	12	5	59	24	100
Self-propelled scrapers.....	37.9	62.7	1953	12	10	63	15	100
Tractor-scrapers...	26.6	74.6	1953	14	9	55	22	100
Walking Dragline..	11.8	386.2	1953	16	6	37	41	100
Hydraulicking:								
Free.....	7.3	136.5	1st half 1954	27	26	35	12	100
Ejector.....	11.5	87.2	1953	42	21	26	11	100
Sand pump.....	8.8	295.3	1st half 1954	29	22	38	11	100
Dredge.....	8.5	300.0	Est. 1955	38	14	32	16	100

*Supplies include power, fuel, lubricants, etc.
**Labor includes supervision as well as direct and indirect labor.

Table 2. Cost and Performance of Various Stripping Methods, Demerara Bauxite Co. Ltd. (U.S. Dollars)

Tractor-Scraper

	1941	1953
Cu yd per hr per unit	58.4	74.6
Cost per cu yd, $	0.068	26.6
Cu yd per machine per month	11,000	10,000
Round-trip haulage distance, ft	2,300	1,700
Price of tractor, delivered, $	6,180	25,290
Comparative cost of labor.	1	2.5
Capacity of scraper, struck cu yd	12.5	14.2
Tractor hp	130	130

Self-propelled scraper

	1953
Cu yd per hr	62.7
Cost per cu yd, $	0.379
Round-trip haulage distance, ft	4750
Capacity of scraper, struck cu yd	12.1
Bank yd per trip	9.0
Hp at 1800 rpm	150

Walking dragline

	1953
Bank yd per hr	368.2
Cost per cu yd, $	0.118
Boom length, ft	200
Main Engine hp	850
Bank yd per bucket	7.6
Boom angle	25°
Walking rate, ft per hr	1000

Source: MINING ENGINEERING, April 195.5

Free hydraulicking

Cu yd per hr	136.5
Cost per cu yd, $	0.073
Rated pump capacity, gpm	4000
Rated pump head, ft.	250
Engine hp	315
Supply line, diam in.	18
Discharge line, ft.	2000
Nozzle pressure, psi	55

Sand ejector

Cu yd per hr	87.2
Cost per cu yd	0.115
Max discharge line, ft	1000
Discharge line, diam in.	12

Sand Pump

Cu yd per hr	295.3
Cost per cu yd, $	0.088
Max discharge line, ft	3000
Discharge line, diam in.	18
Velocity in discharge line, fps	9.5
Engine hp, continuous	315
Pump suction, in.	14
Pump discharge, in.	12

Dredge

Cu yd per hr	300
Cost per cu yd, $	0.085
Max discharge line, ft	5000
Velocity in discharge line, fps	8.9
Engine hp max, intermittent	500

Front-end Loaders

"In the ore mining phase of an open pit operation shovel and trucks are generally used to mine the ore, but where extreme care in selective mining is necessary, tractor-mounted front-end loaders have developed into very practical pieces of equipment. A rule of thumb might be that it takes slightly more than double bucket capacity for a front-end loader to equal shovel production under ideal conditions. Generally, the purchase price of a front-end loader is less than one-half the purchase price of a shovel for comparable bucket size. So we might say that equipment depreciation costs on a given tonnage rate would be equal or slightly less with a front-end loader than with a shovel.

"Production costs will probably be slightly higher with the front-end loader, but advantages in selective mining because of the greater maneuverability of the front-end loader often prove well worth the additional cost. This has been especially true in some unblasted uranium ores.

"If severe digging conditions are encountered, production on a front-end loader will fall off markedly, as they are weak in crowding into a muck pile as compared to a shovel.

Table 3, Truck Haulage Costs at Bagdad Copper Co.

Units and make		Performance: Hours, miles and tons — In ore	In waste	Total	Percent Operated	Operating Cost ($): Fuel	Lubrication	Tires and tubes	Repair labor	Parts	Operating labor	Total
13 22T Dart Cummins	Hours	14,603.0	20,881	35,484.0	68.7							
	Miles	62,300.8	161,395	233,695.8								
	Tons	1,103,526.0	2,031,745	3,135,271.0								
	Miles/gal					0.9259						
	Cost/mile					0.1897	0.0239	0.3519	0.0451	0.1396	0.3561	1.1063
	Cost/ton					0.0135	0.0017	0.0251	0.0032	0.0099	0.0254	0.0788
3 22T Dart W/TG	Hours	2,336.0	1,697.0	4,033.0	23.7							
	Miles	8,999.3	12,296.5	21,295.8								
	Tons	186,344.0	146,501.0	332,845.0								
	Miles/gal					0.6574						
	Cost/mile					0.2669	0.0317	0.3916	0.0850	0.4171	0.3763	1.5686
	Cost/ton					0.0171	0.0020	0.0254	0.0054	0.0267	0.0241	0.1007
8 30T Dart 30 SL	Hours	1,772.0	29,386.0	31,158.0	69.8							
	Miles	8,447.2	236,632.0	245,079.2								
	Tons	174,212.0	3,697,230.0	3,871,442.0								
	Miles/gal					0.8918						
	Cost/mile					0.1960	0.0193	0.3229	0.0453	0.2204	0.3195	1.1240
	Cost/ton					0.0124	0.0012	0.0204	0.0029	0.0140	0.0202	0.0711
6 55T Dart 55-T-1	Hours	4.0	17,550.0	17,554.0	62.3							
	Miles	29.4	128,589.8	128,619.2								
	Tons	790	2,528,020.0	2,528,810.0								
	Miles/gal					0.7119						
	Cost/mile					0.2469	0.0264	0.5308	0.0419	0.2094	0.3657	1.4211
	Cost/ton					0.0126	0.0013	0.0270	0.0021	0.0107	0.0186	0.0723
2 55T Dart Butane	Hours		5,768.0	5,768.0	61.5							
	Miles		40,879.9	40,879.9								
	Tons		828,720.0	828,720.0								
	Miles/gal					0.3843						
	Cost/mile					0.2717	0.0192	0.2539	0.0401	0.1657	0.3876	1.1382
	Cost/ton					0.0134	0.0009	0.0125	0.0020	0.0082	0.0191	0.0561
5 22T Euclid	Hours	157.0	47.0	204.0	5.0							
	Miles	362.5	307.8	670.3								
	Tons	13,586.0	5,140.0	18,726.0								
	Miles/gal					0.6439						
	Cost/mile					0.2625	0.0274	0.1522	0.0528	0.0407	0.5370	1.0726
	Cost/ton					0.0094	0.0009	0.0054	0.0019	0.0015	0.0192	0.0383
1 50T Euclid	Hours		3,073.0	3,073.0	65.2							
	Miles		23,489.5	23,489.5								
	Tons		587,570.0	587,570.0								
	Miles/gal					0.7475						
	Cost/mile					0.2345	0.0454	1.3819	0.0430	0.0720	0.3527	2.1295
	Cost/ton					0.0094	0.0018	0.0552	0.0017	0.0029	0.0141	0.0851
1 E-40 Tourna-rocker	Hours	2.0	265.0	267.0	7.2							
	Miles	4.5	1,858.8	1,863.3								
	Tons	262.0	28,890.0	29,152.0								
	Miles/gal					0.6416						
	Cost/mile					0.1590	0.0118	0.1316	0.1338	0.0616	0.5509	1.0487
	Cost/ton					0.0102	0.0008	0.0084	0.0086	0.0039	0.0352	0.0671
1 E-50 Tourna-rocker	Hours	13.0	364.0	377.0	10.5							
	Miles	46.1	2,306.4	2,352.5								
	Tons	2,745.0	49,462.0	52,207.0								
	Miles/gal					0.7603						
	Cost/mile					0.1341	0.8158	1.5278	0.0518	0.0329	0.4569	2.2193
	Cost/ton					0.0060	0.0007	0.0688	0.0023	0.0015	0.0206	0.0999
40 Totals	Hours	18,867.0	77,031.0	97,918.0	58.7							
	Miles	80,189.8	607,755.7	687,945.5								
	Tons	1,481,465.0	9,903,278.0	11,384,743.0								
	Miles/gal					**0.7868**						
	Cost/mile					**0.2115**	**0.0232**	**0.4090**	**0.0457**	**0.1886**	**0.3483**	**1.2263**
	Cost/ton					**0.0128**	**0.0014**	**0.0247**	**0.0028**	**0.0114**	**0.0210**	**0.0741**

"As mentioned before, costs can vary so widely that depending on the type of material, equipment used and length of haul, it is difficult to give specific costs. I have given below a general cost summary, and they are as follows:

Waste Costs—Ideal with a short haul. Scraper—20¢ (or slightly under) per cu yd.

Shovel-trucks—I think the best we could hope for is around 35¢ a cu yd, and these are total costs not just partial costs.

Direct Costs—Severe with a long haul, 80¢ a cu yd for a scraper up to as high as $1.75 per cu yd, but I imagine there would be no limit to it depending on the length of haul.

Ore Costs—Ideal with a short haul, shovel and trucks, 30¢ a ton.

Front-end loaders—that is debatable again, depending on conditions, say 50¢ a ton, severe with long haul, you could conceivably have a shovel

Table 4, Comparative Truck Costs, Ray Div, KCC

	34-Ton	50-Ton
Average load (tons)	36.14	54.15
Capacity	100.00%	150.00%
Ton-miles per shift	100.00%	134.00%
Operating labor per operating hour	100.00%	100.00%
Fuel per operating hour	100.00%	123.00%
Lubricants per operating hour	100.00%	109.00%
Tires per operating hour	100.00%	157.00%
Maintenance labor per operating hour	100.00%	89.00%
Maintenance parts per operating hour	100.00%	104.00%
Total per operating hour	100.00%	110.00%
Ton-mile cost	100.00%	83.00%

Table 5, Summary of Electric Truck Performance at the Berkeley Pit, July through November, 1960

Days worked	47
Truck trips	922
Tons hauled	58,056
Average haul distance, one-way	0.5 Mile
Average distance on trolley	0.3 "
Tons per hour,	
Working	300
Operational	205
Overall	154
Percent of time,	
Working	46.6%
Process delay	28.4%
Truck	19.4%
Trolley	5.6%
Average availability	75.0%
Production availability	41.6%

Definition of terms:

Work time = load + travel + dump.

Process delay = wait + lunch + personal + supervision

Truck delay = inspection + lub. + repairs and adjustments

Trolley delay = trolley repairs and adjustments

Average availability = total time − truck & trolley delays

Production availability = days worked ÷ total work days in period

Table 6, Cost Estimate Basis, Electric Truck, Berkeley

Fuel & power—gph × ¢/gal. ÷ haul rate = fuel cost/ton
power cost/mo. ÷ total tons = power cost per ton
Tire cost = cost/set ÷ avg. tire life ÷ haul rate
Engine repair—a percentage of diesel fuel cost.
Tune-up expense— " " " " "
Brake expense— " " " " "
Misc. expense— " " " " "
Body repair—flat rate per payload ton
Payroll overhead—percentage of fuel + repair cost
Driver expense—Daily wage rate ÷ tons per shift
Trolley system maint.—$/mile/yr. ÷ annual tonnage
Substation repair—$/unit/yr. ÷ annual tonnage

Comparison of Performance & Cost/Ton Estimates

	450 hp Straight Diesel	700 hp Diesel-Elec.	TR-60/335 Straight Elec.	TR-60/670 Straight Elec.	TR-60/670 Straight Elec.	700 hp Diesel-Elec.
Truck empty weight, tons	35	57	56	57	57	57
Shovel bucket capacity, yards	6	6	6	6	10.5	10.5
Shovel passes per truck	4	7	7	7	4	4
Payload tons per truck	36	63	63	63	63	63
Gross vehicle weight, tons	71	120	119	120	120	120
Loading time, including delays	2.53	4.24	4.24	4.24	2.94	2.94
Trucks loaded per shovel hour	23.6	14.1	14.1	14.1	20.4	20.4
Haul capacity, tons per hour	850	888	888	888	1285	1285
Maximum shovel rate per hour	1148	1148	1148	1148	1836	1836
Shovel capacity, tons per shift	6375	6660	6660	6660	9180	9180
Shovel fleet operating effic.	74%	77.5%	77.5%	77.5%	70%	70%
Length of haul one-way, miles	1.0	0.68	0.48	0.48	0.48	0.68
Main haul grade	4.5%	8%	15%	15%	15%	8%
Elevation gained in feet	200	200	200	200	200	200
Round trip time in minutes	13.68	13.24	11.11	10.22	8.92	11.94
Tons hauled per 50-minute hour	131	238	283	309	353	264
Trucks required per shovel	6–7	4	3	3	3–4	5
Estimated truck costs:						
Cost per operating hour	$10.43	$16.91	$14.26	$17.28	$15.20	$16.59
Cost per ton hauled, cents	7.963	6.937	5.038	5.592	4.307	6.284
Percent variance from 34-T diesel	—	−12.88%	−36.73%	−29.77%	−45.91%	−21.08%

truck operation as high as $1.50 a ton and front-end loaders as high as $2.00 a ton.

"In summarizing then we might say what seems to be an obvious statement under ideal conditions, scrapers, shovels and front-end loaders in that order will give you the cheapest cost and each set of given equipment will dictate what equipment should be used. When it appears two methods are equal, then experience must be your guide."

Demerara Bauxite Co. Ltd., British Guiana, published its stripping costs in MINING ENGINEERING, April 1955. A summary of cost and performance data is given in Tables 1 and 2. Demerara's costs are based on records kept by the company, which employed all the methods covered.

Truck Haulage at Bagdad

In October 1958, Bagdad Copper Corp. reported its truck haulage costs in E&MJ. Bagdad's orebody lies in a deep ravine, necessitating a fairly long haul from the pit. At the time of the report, distance of round-trip waste haul was about 3.2 miles and that of the ore haul 1½ miles. Production was 6776-tpd ore and 30,000-tpd waste. The cost-per-ton varied by truck from 3.8¢ to 10¢ with an average of 7.4¢ (see table 1).

Under most mine accounting systems, haulage costs fluctuate widely month by month as well as year by

Table 7, Comparison of Haul Runs Used In Truck Performance Estimates

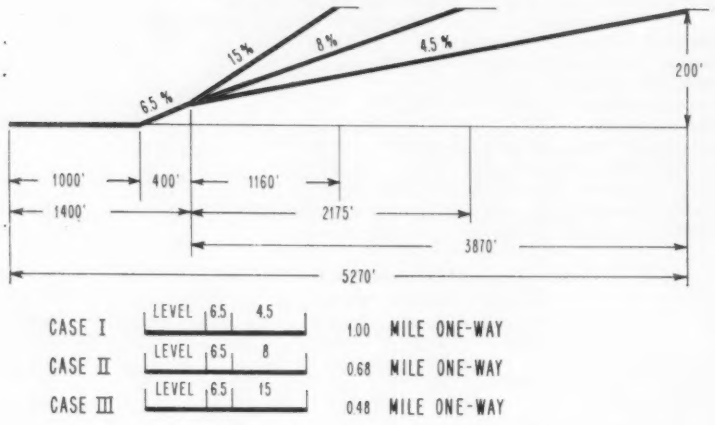
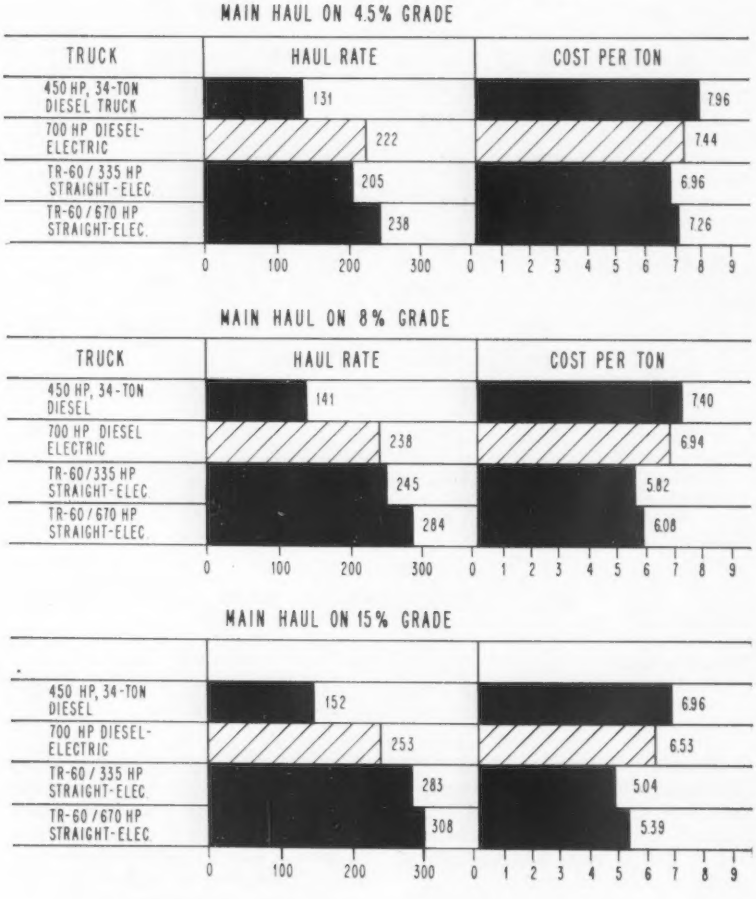


Table 8, Haul Rate and Cost-Per-Ton Estimates for Compared Trucks on Various Grades



year. In the mid-1950's one operator's 35-ton truck fleet costs varied from $7.00 to $16.00 per operating hour and rose about 60% in a two-year period. Another 35-ton model at the same operation started at a comparable cost level but its operating costs increased more than 100% over the same two-year period.

A breakdown of costs for one period showed 25% for operating labor, 12% for operating supplies and fuel, 56% for repairs and 7% for tires.

In an effort to cut costs, many mines are changing to larger units. Manufacturers, anticipating the move, have recently introduced models above 50-ton capacity. K. W. Dart's 95-ton capacity truck is presently tops for payload size. (Western Contracting Co.'s 175-ton model at Bingham is a custom-built unit.)

J. C. Van De Water, general superintendent of mines, explained how larger units cut costs at KCC's Ray Mines Div. Table 4, from MINING CONGRESS JOURNAL, September 1959, shows a ton-mile cost for a 50-ton truck to be 83% of that for a 34-ton truck with productivity per 50-ton truck 134% of the 34-ton model. Note the relative cost of tires for the two models.

Experience at Kaiser Steel's Eagle Mountain mine brought much the same results. Martin J. Hughes, manager, in an article in MINING CONGRESS JOURNAL, May 1960, wrote: "The introduction of large trucks has resulted in a considerable saving in haulage costs. During 1958, the cost of hauling with the 36-ton trucks was 87.9% of the cost of hauling with the 22-ton trucks, and the cost of hauling with the 64-ton trucks was 68.8% of the cost of hauling with the 22-ton trucks. These percentages are based upon costs which were obtained under conditions that were equal with respect to haul lengths, grades and road conditions."

Dead Weight Being Cut

An important development associated with the recent size trend in trucks is the trend to increase payloads by decreasing the trucks' dead weight. Anaconda lowered dead weight of its trucks at Week Heights, Nev., by building a corrugated-steel, rubber-cushioned body. (See E&MJ, December 1960, p 116). Oliver Mining Co. got a 5-ton increased payload on a 40-ton model by ordering it equipped with T-1 steel, one of the new high-strength steels recently developed (see photo, page 214).

One of the most significant truck cost studies was made by the Anaconda Co. for its Berkeley Pit operations. This is where the electric truck made its appearance in the copper mining industry. Richard M. Steward, director of mining research, and Charles W. MacQueen, assistant research engineer, reported that study at the recently concluded annual meeting of the AIME. Tables 5, 6, 7 and 8 summarize the study.

IDEAL Cement Co's 5.4-mile conveyor system moves rock for 2.46¢ per ton mile.

Four Ways to Reduce Conveyor Costs

E. R. TRAXLER

As a companion piece to a survey of the world's largest conveyor systems which will be published in a subsequent issue of E&MJ, Mr. Traxler has offered four ways to reduce the initial and operating cost of large conveyor systems. Hypothetical designs are established and the comparative economics given for each system. Economies for each of the suggestions are considerable.

WHEN DESIGNING large conveyor belt units, several points are worthy of consideration from the standpoint of economics. These operational or design points are: (1) Use of higher belt speeds, (2) use of steeper angle or deeper trough idlers, (3) use of long-center conveyor design vs several shorter conveyor units, and (4) use of several lower hp motors and reducers for a conveyor drive in place of a single motor and reducer or drive assembly.

1. Use Increased Belt Speeds

Actual load transport requirements must be studied for each individual case. The size and type of the specific material may place some restrictions on the choice of belt speed. A hypothetical case can be set up as follows by assuming a set of normal conveyor conditions:

1. 2000 ft between terminal pulleys.
2. 1800 tph maximum of minus-4-in. stone to be transported.
3. Single lagged drive pulley snubbed to give 220° belt wrap.
4. Automatic type take up.
5. Horizontal conveyor with no lift or decline.
6. Vulcanized splices in the belt.
7. Compare costs of the conveyor with belt speeds of 400, 550 and 750 fpm.

Estimated belt widths, calculated belt tension and power requirements are shown in Table 1.

It is generally considered that with higher belt speeds the belt top cover thickness should be increased slightly. On this basis, we have assumed 5/16-in. top cover for the 48-in. belt, 7/32-in. top cover for the 42-in. belt and 1/4-in. top cover for the 36-in. belt width. Assuming standard types of idlers, conveyor structure, drives and take-ups, the initial cost as compared to that for the 48-in. unit with 400 fpm belt speed would be approximately 11% less for the 42-in. system with 550 fpm belt speed and 18% less for the 36-in. system with 750 fpm belt speed.

Further economies would be shown on the replacement belt costs as compared with the 48-in. belt and amount to approximately 17% less for the 42-in. belting and 26% less for the 36-in. belting.

Table 1, Conveyor Design Requirements at Various Speeds

Belt Speed, (Fpm)	Possible Belt Width, (In.)	Max. Belt Operating Tension (Lb. per in.)	Horsepower Required at Drive Pulley	Probable Motor Rated hp
400	48	281	120	150
550	42	245	127	150
750	36	220	135	150

Table 2, Long-Center vs Short-Center Conveyor Units

	Single 5000-ft center unit	Five 1000-ft units
Hp required at the drive	305	81 each for 4 70 for 1 or 394 total
Probable motors	Dual 250 hp / 100 hp	100 each or five 100-hp motors
Calculated belt operating tension	470 lb per in.	170 lb per in. for 4 150 lb per in. for 1
Approx. belt length required	10,050 ft	10,350 ft

2. Use Deep Trough Idlers

For some years the Germans in their strip mining operations have made use of idlers with 30° concen-

Mr. Traxler is senior development engineer, conveyor belts, B. F. Goodrich Industrial Products Co.

trating angle in place of the 20° commonly used in the U.S. Improved conveyor belting constructions, able to withstand the more severe transverse flexing, are making the use of deeper trough idlers possible.

A 48-in. belt at 400 fpm can handle 1800 tons of stone per hr with regular 20° troughing idlers. A 42-in. belt with 35° troughing idlers can handle the same 1800 tph with the same 400 fpm belt speed. The cost of the 42-in. belt system would be approximately 11% less than for the 48-in. belt system.

With the deep trough idlers of the 35° or 45° type, several points of conveyor design should be kept in mind:

1. Vertical curve radii must be ample not to overstress or buckle belt edges.
2. Transition distance between last troughing idler and a terminal pulley must be sufficient to not overstress the belt.
3. Belt speed should be 400 fpm or above to satisfactorily convey the material through the transition point for discharge over the head pulley.

3. Use Long Center Conveyors

The existing contours of the land, the type of material to be handled, motor sizes on hand or desired and a careful check of the required power, maintenance and belt costs are only a few of the considerations necessary in studying the feasibility of one long conveyor unit as compared to dividing into several shorter flights. A hypothetical case can be outlined as follows:

1. 500 ft total required haulage length.
2. 1800 tph maximum of minus-4-in. stone to be transported.
3. 42-in. belting width with 550 fpm belt speed.
4. Automatic type take up.
5. Horizontal haulage with no lift, or drop for the single unit consideration but assumed 6-ft lift for each of four units when considering the five-unit system.
6. Vulcanized belt splices.

Power and tension requirements are estimated in Table 2.

The 5000-ft center unit will require the more expensive higher strength conveyor belting but the initial cost of the single long conveyor will be approximately 8% less than for the total of the five shorter ones. The cost (without belt) of the 5000-ft center conveyor is approximately 25% less than for the total of the five shorter ones. This results from the elimination of four transfer points with their installations of motor, reducer, drive, transfer and belt take-up equipment. Most of the belt top cover wear results from the material loading at a transfer point. In the belt estimates for this comparison, a ¼-in. top cover was chosen for the belting with the five-flight system and a 3/16-in. top cover for the single longer conveyor consideration.

Replacement belt costs must be considered and this is of course higher with the single long center unit. In the foregoing case, the saving on the initial cost of the single unit system just about makes up the difference in cost required by the stronger belting for the first replacement.

There are other points favoring the single-unit design:

1. Lower power cost resulting from 305 hp vs 394 hp for the 5-flight system.
2. Lower maintenance cost because of the elimination of four drives, take-ups and transfer equipment.
3. Less chance for severe belt damage. Serious belt damage most often occurs at a loading point and with the single unit, four transfer points are eliminated.
4. With some materials, transfer chutes are subject to clogging. Some estimates have been made ranging to $4000 or $5000 per year saving per transfer point eliminated.

An 11,800-ft center conveyor unit in a 7-flight system is handling shale and limestone for the Ideal Cement Co.'s Ada, Okla. plant. In a paper for the 1961 annual meeting of AIME, Mr. Thomas B. Douglas, vice president, operations, for Ideal Cement gave the present calculated values for this 5.4-mile conveyor haulage cost. His present cost per ton, based upon 1000 tph with one 8-hour shift per day and a 5-day work week, was 13.3¢, resulting in approximately 2.46¢ per ton mile. At half production this cost is 23.6¢ per ton or 4.36¢ per ton mile.

In the initial studies for this Ideal Cement haulage job, the estimated capital investment for a railroad system was approximately 50% less than for the belts, and truck haulage was calculated at approximately 30% less than the belt system. However, the estimated operating costs for the 5.4-mile haul were calculated at approximately 40% less for belts than railroad and 33% less for belts than for trucks. The belt system was advantageous in permitting the crossing of two highways and two railroads along the 5.4-mile route. The 5.4-mile belt system is being operated and maintained with two men and one supervisor.

4. Multi-Motor vs Single Motor Drives

A 600-hp would rotor motor might have a control with 10 or 12 points for starting acceleration. This motor might be coupled with a gear reducer to a single drive pulley. This conveyor drive could also be designed with two drive pulleys and three 200-hp motors. One 200-hp motor and reducer could be coupled to each end of the primary drive pulley shaft and a third 200-hp motor and reducer could be coupled to one end of the secondary drive pulley shaft. Four-point starting controls could be used with each motor and these could be set to accomplish 12-point acceleration.

Here the cost of the single motor drive assembly with the one 600-hp motor and its starting equipment, couplings and gear reducer is very close to that for the three 200-hp motor assemblies. The single-motor drive may be less expensive by 5- or 6%. A higher hp drive such as a single 1500-hp motor assembly vs three 500-hp drive assemblies may show a little greater spread compared to the single drive. The 1500-hp single drive may be 12- to 15% less expensive than the three 500-hp drive units.

The advantages of the multi-motor drive which may offset its slightly higher cost are:

1. Flexibility. With the loading rate required in the initial stages of a conveyor operation, perhaps two 200-hp motors would be sufficient. Later when loading rates required the full design hp, the third 200-hp motor could be added.
2. One of the lower hp motors may be more readily obtainable and is of course cheaper to carry as a spare.
3. On long horizontal conveyors, a 2-pulley type of drive often permits lower belt operating tension and therefore lower belt cost. On high lift slope units, however, the belt tensions are such that the two-pulley drive may not cause any lower belt operating tension than the single type.

Underground: High Cost But Richer Ore

UNDERGROUND mining costs are considerably more variable than open-pit costs, with block caving and trackless-type room and pillar mining the only underground methods nearly competitive with pits on a cost-per-ton basis. Even when underground mines are classified on a method basis, production and cost vary considerably. For example, a recent E&MJ survey of room and pillar mines shows ton-per-man-shift variations (all employees) ranging from 3 to 47.

Several items of machinery were associated with the high production-per man shift figures. All mines using jumbos were in the high tonnage category, as were those using trackless mining, small shovels, Transloaders and conveyors. However, high productivity is not necessarily associated with high profit: the small operator by using small equipment has the advantage of being able selectively to mine narrow leads.

Wide cost variations were given by John W. Chandler in an article in MINING CONGRESS JOURNAL, November 1959. Chandler, mining engineer for American Metal Climax Inc., made a survey of various mines and came up with the figures in Tables 1 and 2. For underground mining, the cost varied from a low of $1.15 per ton to a high of $18.72 per ton.

Costs also vary by area. Tables 3, 4 and 5, which represent lead-zinc mines in different parts of the country, illustrate the higher cost of mining in the Western U.S. These tables were originally published in *Economics of the Mineral Industries, Seeley W. Mudd Series*, AIME, in an article by Paul M. Tyler.

Tyler also wrote that rock-bottom figures are probably about $1.00 per ton for mining and 60¢ per ton for milling.

After writing that a rough and ready rule for estimating total direct mine costs for many years was to double the labor cost (number of employees and wage rates are relatively easily obtained figures), Tyler qualified the statement by noting the decreasing labor to supplies ratio. Most mines will fall in the 60:40 to 40:60, labor-to-supplies ratio and the trend is for the labor ratio to decrease in

Table 1, Direct Mine Operating Costs for Various Mining Methods, Period 1955-59

Mining Method	Tons Mined Per Month[1]	Direct Mining Costs/Ton[2] High	Low	Average[3]	Labor-Percent Of Total Cost[3]
Square setting	439,330	$18.72	$6.22	$10.20	71.2%
Cut and fill	585,300	14.73	3.07	.6.69	56.7
Shrinkage	305,820	8.12	1.75	3.92	N.A.
Room and pillar (trackless type)	733.220	2.41	1.16	2.05	43.7
Sub-level stoping	1,547,410	4.71	1.06	2.37	56.9
Sub-level caving	118,150	N.A.	N.A.	4.97	63.3
Block caving	1,803,150	2.25	1.15	1.46[5]	54.2
Oven pit[4]	5,198,060	1.15	.21	.32	36.4

[1] Total aggregate tonnage of ore mined each month except for open pits (see footnote 4).
[2] Includes exploration and development, stoping, haulage, hoisting, pumping, and general underground and surface costs.
[3] Weighted average on the basis of tons produced from each mine.
[4] Cost is per ton of "material" and is based on total tons of ore and waste handled.
[5] This average may be on the high side due to lack of information covering a number of efficient operations.
N.A.—Not Available.
Source: John W. Chandler in Mining Congress Journal, November, 1959.

Table 2, Drill Bits and Rods Average Cost per Foot of Hole for Various Drilling Rates

Type Drill—Bore & Rate of Penetration	Bit Size In In.	Bit Life In Ft	Bit Cost (each) $	Cost Per Ft. Hole $ Ft	Steel Size	Steel Life In Ft	Steel Cost $	Cost Per Ft. Hole $ Ft
Jackleg 2⅝-in.								
Over 30-in./min	1⅜	1,500	12.85[1]	.009	⅞ × 4¼-in. sh	3,000	17.00[2]	.009
20 to 30-in./min	1⅜	700	12.85	.018	Alloy Steel	1,500	9.00	.017
15 to 20-in./min	1⅜	500	12.85	.026	8-ft section	800	26.00	.033
Drifters 3½-in.								
Over 30-in./min	1⅝	1,500	15.15[1]	.010	1¼-in. lug	3,000	31.10[2]	.014
20 to 30-in./min	1⅝	700	15.15	.022	carbon steel	1,500	9.50	.027
15 to 20-in./min	1⅝	500	15.15	.030	12 ft section	800	40.60	.051
Drifters L.H. 4-in.								
Over 30-in./min	2	1,500	18.05[1]	.012	1-in. hex. exten.	2,000	17.50	.009
20 to 30-in./min	2	700	18.05	.026	carburized steel	1,500	17.50	.012
15 to 20-in./min	2	500	18.05	.036	4-ft section	1,000	17.50	.018
Crawl-IR 4½-in.								
Over 30-in./min	3	3,000	47.20[1]	.016	1½-in. hex. exten.	4,500	45.00	.010
20 to 30-in./min	3	1,500	47.20	.031	carburized steel	2,500	45.00	.018
15 to 20-in./min	3	500	47.20	.094	10-ft section	1,500	45.00	.030
Drillmaster (DHD) 3¼-in.								
Over 30 ft/hour	6	10,000	425.00[1]	.043	4-in. OD alloy	47,000	470.00	.010[3]
20 to 30 ft/hour	6	2,500	425.00	.170	steel tubing	47,000	470.00	.010
15 to 20 ft/hour	6	500	425.00	.850		47,000	470.00	.010

[1] Bit cost includes reconditioning cost on the following basis: grinding wheel cost $5.00 each—Labor at $2.00 per hour.

1⅜-in.	Bits—100	regrinds	per	wheel	
1⅝-in.	" 100	"	"	"	
2-in.	" 50	"	"	"	
3" in.	" 25	"	"	"	
6" in.	" 3	"	"	"	

[2] Reconditioning cost at $1.50 per thread or per shank for over-all of six reconditionings per rod.
[3] Low steel cost because down-the-hole drill transfers no energy through steel.
[4] "Down-the-hole" type drill.

Table 3, Mining and Milling Costs per Ton at the Gray Mine, Galena, Ill., in June 1956

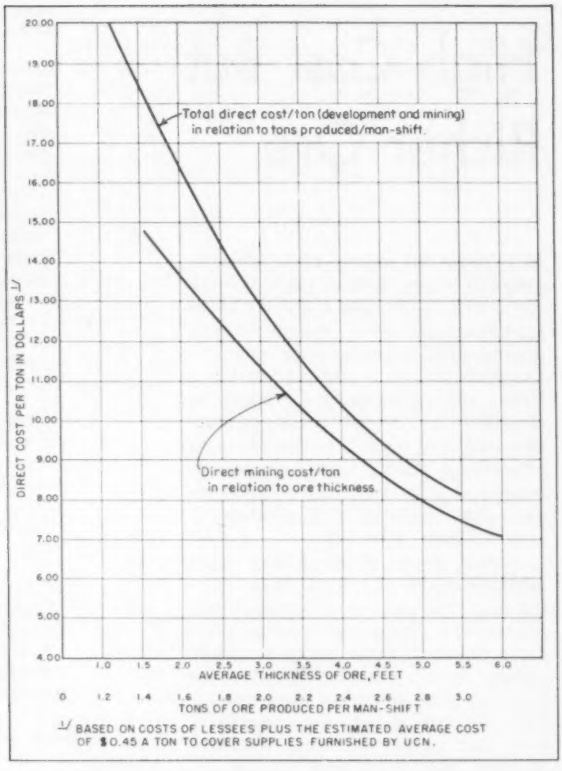
	Labor	Power	Repairs Explosives, Supplies	Other	Total Cost
Drilling	$0.216	$0.037	$0.067	$0.014	$0.3335
Blasting	0.008	—	.181	—	.1898
Loading	0.091	.007	.102	.006	.2065
Ore haulage	0.119	.004	.071	.010	.2039
Roof trimming	0.007	—	—	—	.0075
Development	0.017	.004	.001	.002	.0235
General mine expense	0.118	.033	.035	.027	.2132
Total Mine	0.576	.085	.457	.059	$1.1779
Pumping	0.005	.108	.038	—	.1509
Milling	0.271	.177	.260	.039	.7471
General	0.178	—	.046	.145	.3695
Grand Total	$1.030	$0.370	$0.801	$0.243	$2.4454

Source: Economics of the Mineral Industries, Seeley W. Mudd Series, AIME, 1959.

Table 4, Western Lead-zinc Mine Stoping Costs per Ton of Ore Broken, March 1956

	Salaries and Wages	Supplies	Power	Total
Drilling and blasting	$1.42	$0.62	$0.10	$2.14
Mucking	1.74	.05	—	1.79
Timbering	1.04	.70	.01	1.75
Track	0.02	.04	—	0.06
Filling	0.04	.04	.02	.11
Lights	0.02	—	—	.02
Ventilation	0.05	—	.20	.25
Engineering, etc.	0.01	.01	—	.06*
Superintendence	0.62	—	—	.62
Total Stoping Cost	$4.96	$0.46	$0.33	$6.80*

*Includes $0.04 of "Other costs."
Source: Economics of the Mineral Industries, Seeley W. Mudd Series, AIME, 1959.


Total direct cost/ton (development and mining) in relation to tons produced/man-shift.
Direct mining cost/ton in relation to ore thickness.
DIRECT COST PER TON IN DOLLARS 1/
AVERAGE THICKNESS OF ORE, FEET
TONS OF ORE PRODUCED PER MAN-SHIFT
1/ BASED ON COSTS OF LESSEES PLUS THE ESTIMATED AVERAGE COST OF $0.45 A TON TO COVER SUPPLIES FURNISHED BY UCN.

THE ABOVE chart, which represents average costs at ten small uranium leases, shows direct cost in relation to ore thickness and in relation to productivity. Source: USBM Information Circular 7922. Data compiled by W. L. Dare.

Table 5, Comparison of Costs per Ton at Pend Oreille

	1953	1950
Mining and development	$1.94	$3.54
Milling	0.71	1.07
Other operating costs.	0.33	0.72
General expense and taxes	0.28	0.76
Total operating cost	$3.26	$6.09
Depreciation	0.79	0.68
Depletion	—	—
Income tax provision	0.08	0.13
Total cost per ton	$4.13	$6.90

Source: Economics of the Mineral Industries, Seeley W. Mudd Series, AIME, 1959.

relation to supplies. The estimated ratio could be fixed more nearly by a knowledge of the production per man shift—low per-man-shift tonnages would indicate a high labor to supplies ratio and vica versa.

Tyler also offered the following general costs and rules-of-thumb: "An ordinary drift, up to say 7 by 9 ft

Table 6, Weighted Averages of Costs from Ten Small Uranium Mines in Colorado. Direct cost per ton of ore mined.

	Labor	Super-vision	Explo-sives	Drill steel and bits	Fuel oil, gas, and elec-tricity	Repairs and main-tenance	Equip-ment rental	Other sup-plies[1]	Total
Development	$1.25	$0.20	$0.17	$0.06	$0.13	$0.07	$0.07	$0.16	$2.11
Mining	5.40	.85	.69	.23	.53	.34	.37	.65	9.06
Total	6.65	1.05	.86	.29	.66	.41	.44	.81	11.17

Indirect cost per ton of ore mined[2]

Depreciation[3]	$0.75
Transportation	.15
Social security	.13
Workmen's compensation	.26
Unemployment compensation	.14
Other insurance and taxes	.07
Accounting and other	.15
Total	$1.65

Costs in units of labor and explosives
Ore produced per man-shift (labor and supervision) ..... tons 2.3
Explosives used per ton or ore ..... pounds 3.1

[1] Includes $0.45 per ton to cover the estimated cost of rail, pipe, timber, and other supplies furnished by Union Carbide Nuclear Co. (UCN).
[2] Does not include UCN costs for exploration, engineering, administration, taxes and amortization of capital for certain initial development.
[3] Depreciation of lessees equipment.
Source: USBM Information Circular 7922

Table 7, Average Prices for Supplies and Equipment, 1955-57, Uravan-Naturita Area

Item		1955	1956	1957
Scraper hoist, 2-drum, compressed-air 5-hp, 1100-lb pull at 80 psi	each	$1160.00	$1275.00	$1400.00
Drill, 2⅝-in. bore, integral with 4-ft, single-acting pneumatic leg	do.	695.00	785.00	865.00
Drill steel, ⅞-in. hexagonal:				
Integral with tungsten carbide chisel bit:				
4-ft length	do.	16.10	17.75	19.50
5-ft 3-in. length	do.	16.45	18.10	19.90
6-ft length	do.	17.25	18.95	20.85
Carbon alloy, threaded or tapered bit end:				
4-ft length	do.	3.95	4.30	4.75
5-ft length	do.	6.55	7.20	7.90
6-ft length	do.	7.25	7.95	8.75
Drill bits, 1-use-types, 4-wing:				
Type A, 1⅞₁₆- to 2-in., tapered socket:				
Single bit	do.	.20	.20	.245
Single bit in keg lot (300)	do.	.19	.19	.23
Type B, 1⅞₁₆- to 2-in., tapered socket:				
Single bit	do.	.20	.20	.23
Single bit in keg lot (300)	do.	.19	.19	.22
Type C, 1¾-in., tapered socket:				
Single bit	do.	.49	.49	.55
Single bit in keg lot (300)	do.	.49	.49	.54
Type D, 1¾-in., insert-type, threaded:				
Single bit	do.	—	—	4.80
Wire rope, preferred-plow, hemp-center, 6 by 19:				
⅜-in.	per ft	.157	.166	.18
½-in.	do.	.187	.198	.21
Dynamite, 40- and 45-percent semigelatin:				
In 20-box lot (½ ton)	per 50-lb box	9.75	10.50	11.25
Safety fuse, free-core: 3000-ft reel	each	35.00	35.00	36.00
Blasting caps, No. 6: 10-box lot (1000)	do.	19.85	21.65	23.95

Source: USBM Information Circular 7922

Table 8, Development-work Rates Paid by Union Carbide Nuclear Co. in 1957

Item and specifications		Rate
Raises:		
1-compartment, without timber	per ft	$8.00
1-compartment, timbered	do.	10.00
Drifts:		
7 × 7 ft, without pipe or track	do.	11.00
7 × 7 ft, with pipe and track	do.	15.00
6 × 7 ft, without pipe or track	do.	10.00
6 × 7 ft, with pipe and track	do.	14.00
Crosscuts:		
4 × 6 ft, without pipe or track	do.	8.00
4 × 6 ft, with pipe and track	do.	10.00
Inclines:		
Exceeding minus 12°, including pipe and track	do.	15.00
Test-hole drilling:		
Aimed as required	do.	.25
Timbering:		
3-piece, lagged and blocked	per set	6.50

Source: USBM Information Circular 7922

Table 9, Arizona Small Mine Cost Data

"Break Even" Ore Values For Small Mines

Type of Ore	Grade %	Total Value	Return to Shipper*
Gold-silver		$22.00	$16.00**
Copper (at 32¢/lb.)	4	25.60	16.00
Lead (at 12¢/lb.)	15	36.00	16.00
Zinc (at 13¢/lb.)	25	65.00	16.00

* Freight paid by smelter.
** Mining cost at $12.00 per ton plus miscellaneous costs at $4.00 per ton.

Small Mine Pay Scale

Worker	Base Pay	Actual Cost*
Miner	$15.00	$18.69
Mucker	14.00	17.44
Foreman	16.00	19.93

* Cost to the mine operator is figured as follows:

Miner's base pay		15.00
Add 1/6 of weekly overtime		1.25
Payroll wage per day		$16.25
Social Security (3% of $16.25)	= $0.49	
Unemployment (3% of $16.25)	= 0.49	
Industrial Insurance (9% of $16.25)	= 1.46	2.44
Actual cost per shift		$18.69

Source: PAY DIRT, Aug. 19, 1960

and largely untimbered, costs all the way from about $20 to $60 or more per ft; in the United States a rough average is perhaps around $30 to $40 a ft, of which $10 represents indirect costs. A raise, 4x4 or 6x6 ft, is likely to cost around $20 a ft. Sinking a three-compartment shaft may be estimated at $250 to $500 a ft, excluding erection of headframe, hoist, and surface equipment. At uranium mines on the Colorado Plateau (IC 7726), a typical 'deep' vertical two-compartment shaft, timbered, averaged nearly $100 per ft for direct cost to which must be added about $50 a ft more for indirect costs including surface equipment. Direct cost for a shallow shaft was reported as being only $75 a ft for actual sinking plus $40 to cover the cost of plant construction and installation. A single-compartment inclined shaft on the Plateau cost from $25 to $50 a foot, depending upon the size of the opening and the length of the incline.

"Other rule-of-thumb approximations of unit costs . . . are $250 per ton of capacity for mine cars, $200 per man for a dryhouse, $10 per sq ft for ordinary one-story houses and $300 per ton of daily capacity for underground face equipment. Pipe lines cost about 50% more than the material cost and in the Western United States the unloading of materials costs about 4¢ a pound.

"At least one company estimates start-up costs for a new mine at 10% of the capital cost. New construction cost estimates ordinarily include a contingency reserve of 20%, and engineering costs are often figured at 5 to 10% of the cost of a job."

Cost statistics from Michigan iron mines, compiled by H. J. Hardenberg and R. C. Reed, show a direct cost of underground mining (all mines) of $4.98 per ton in 1959. Of this amount, labor constituted $3.46 and supplies $1.52. In 1958, total cost amounted to $4.51 and the five-year average was $4.32.

(*Continued on next page*)

Table 10, Costs at Mesa No. 2 Mine, Kerr-McGee Oil Industries Inc., June 1957 – June 1958

Ore mined, tons: 40,600 — Mining method: Room and pillar

Direct cost per ton of ore mined:

Item	Labor	Supervision	Drill steel and bits	Explosives	Fuel oil, etc.	Equipment rental	Other supplies	Total
Development, in waste	$0.64	$0.22	$0.05	$0.17	$0.11	$0.03	$0.12	$1.34
Mining	2.82	.96	.19	.67	.49	.11	.51	5.75
Equipment maintenance	.47	—	—	—	—	—	.60	1.07
Total	3.93	1.18	.24	.84	.60	.14	1.23	8.16

Indirect cost per ton of ore mined:

Item	Cost per ton
Engineering and geological expense	$0.18
Depreciation, equipment	.59
Auto and truck expense	.27
Camp and commissary expense	.29
Ore haulage (excess of allowance)	.64
Taxes, insurance, etc.	.27
General administration	.49
Total	2.73
Exploration drilling, cost per ton of ore mined	$1.10

Costs in units of labor and explosives:

Item	Development	Mining	Total
Man-hours per ton of ore and waste	0.2	1.1	1.3
Tons ore and waste per man-shift	—	—	6.4
Tons ore per man-shift	—	—	5.2
Explosives, 35-percent semigelatin lb per ton.	.7	2.5	3.2

Source: USBM Information Circular 8011.

Table 11, Costs at Black Rock Tungsten Mine, Wah Chung Mining Corp., Jan. to June 1957

Ore mined: 71,442 tons

Mining and development costs per ton:

Drilling and blasting	$1.77
Mucking	.65
Slushing	.62
Tramming	.51
Timbering	.19
Pipe and track	.23
Compressors	.16
Lubrication	.02
General shop	.22
Nipping	.15
Lighting	.05
Sampling ore	.10
Diamond drilling	.35
Equipment rental (trucking ore)	.57
General mine expense	.03
Allocated expense including depreciation, supervision, etc.	2.36
Total	7.98

Total mining and development costs:

	Total	Per ton	Distribution, percent
Labor	$238,236	$3.33	41.8
Materials	163,211	2.29	28.6
Other (including depreciation, supervision, etc.)	168,426	2.36	29.6
Total	569,873	7.98	100.0

The prevailing wage rate was $2.11 per hour for miners with time and a half paid for all work in excess of 8 hours a day or 40 hours a week. Mining was on a contract basis. Crosscuts, drifts, and raises were paid on a linear foot of advance, stopes in cubic feet of excavation, and mucking and tramming by the ton.

Total average cost per man-shift of all wage earners at the mine, including incentive bonuses, was $26.75.

Source: USBM Information Circular 7945.

After adding deferred costs (51¢), taxes (84¢), general overhead ($1.19), transportation ($3.20), marketing (8¢), royalty (37¢) and Federal income tax (17¢), the total 1959 cost-per-ton amounted to $11.34. Costs in these mines rose 50% between 1950 and 1960.

Selective Mine Costs Are High

Tables 6, 7 and 8 are cost figures for 10 small uranium mines on the Colorado Plateau, operating under lease from Union Carbide Nuclear Co. These figures were compiled by W. L. Dare and published in USBM Information Circular 7922.

The high cost at these properties is attributed to the mining method which is "simply to follow the ore and leave open stopes behind." The small equipment used permits a high degree of selective mining necessary for the irregular, discontinuous layers of ore mineral within sandstone.

"Break even" ore values for small mines and a small mines pay scale (Table 9) were given in PAY DIRT, Aug. 19, 1960, by Prof. H. E. Krumlauf of the University of Arizona. Krumlauf estimated small mines cost at $16.00 per ton and gave a labor cost of $18.69 per shift for miners.

At a larger uranium operation (Table 10), about 5000 tpm are extracted in a room and pillar mine. Costs run about the same as those at the ten leases of Union Carbide Nuclear Co. Equipment is small and some

Table 12, Mining Costs at Schwartzwalder Mine Denver-Golden Oil & Uranium Co. (Uranium)

Schwartzwalder mine — July, August, and September 1958

Tons ore to bin: 5,337 — Tons ore and waste broken: 7,270

Shrinkage stoping and major development

Items	Supervision	Labor	Bits (steel)	Explosives	Timber	Power	Transportation	Prospecting	Maintenance	Miscellaneous	Total
Ore to bin:											
Stoping	$0.74	$3.04	$0.22	$0.76	$0.19	$0.33	$0.19	$0.44	$0.11	$0.73	$6.75
Development in ore	.08	.72	.03	.08	.02	.03	.02	.05	.01	.08	1.12
Development in waste	.30	2.70	.07	.12	.05	.05	—	.01	—	.15	3.45
Mining total	1.12	6.46	.32	.96	.26	.41	.21	.50	.12	.96	11.32
Rock broken:											
Stoping	.61	2.87	.17	.52	.14	.22	.11	.27	.06	.53	5.50
Development in ore	.07	.60	.02	.06	.02	.02	.01	.03	.01	.06	.90
Development in waste	.14	1.27	.04	.12	.03	.05	.03	.06	.01	.12	1.87
Mining total	.82	4.74	.23	.70	.19	.29	.15	.36	.08	.71	8.27

Table 13, Stoping Costs at Schwartzwalder Mine

Schwartzwalder mine
Tons ore to bin: 5,337
Shrinkage stoping

July, August, and September 1958
Tons ore-waste broken: 6,616

Items	Supervision	Labor	Bits (steel)	Explosives	Timber	Power	Transportation	Prospecting	Maintenance	Miscellaneous	Total
Ore to bin:											
Stoping	$0.74	$3.04	$0.22	$0.76	$0.19	$0.33	$0.19	$0.44	$0.11	$0.73	$6.75
Development in ore	.08	.72	.03	.08	.02	.03	.02	.05	.01	.08	1.12
Development in waste	.02	.15	—	.02	—	.01	—	.01	—	.02	.23
Mining total	.84	3.91	.25	.86	.21	.37	.21	.50	.12	.83	8.10
Ore and waste broken:											
Stoping	.60	2.45	.19	.61	.15	.26	.15	.36	.08	.60	5.45
Development in ore	.07	.58	.02	.07	.02	.02	.02	.04	.01	.07	.92
Development in waste	.01	.12	—	.01	—	.01	—	.01	—	.01	.17
Mining total	.68	3.15	.21	.69	.17	.29	.17	.41	.09	.68	6.54

Table 14, Costs at Giant Yellow Knife

Stoping Performances	1957	1958	1959	1960
Breaking tons/man shift	60.2	64.2	88.0	87.4
Slushing tons/man shift	54.0	69.2	95.0	88.3
Slushing waste fill tons/man shift	71.0	82.7	84.0	91.0
Placing hydraulic fill tons/man shift	122	85	119	159

Direct Stoping Costs	1957	1958	1959	1960
Waste fill stopes:				
Tonnage broken	198,717	100,471	86,832	74,506
Direct cost/ton broken	$ 2.50	$ 2.24	$ 1.76	$ [4]1.85
Tailings fill stopes:				
Tonnage broken	70,778	172,323	217,939	280,721
Direct cost/ton broken	$ 2.74	$ 2.11	$ 1.69	$ 1.66
All-stoping cost/ton milled (direct)	$ 2.24	$ 2.05	$ 1.63	$ 1.69

Table 15, Costs at Reeves MacDonald Mines Ltd. (Pb-Zn)

	1958	1959 (8 mo)
Ore Milled	417,076	283,313
Mining	1.204	1.113
Milling	0.927	0.921
Direct Operating	0.383	0.368
Total	2.514	2.402
Mining		
Supervision	0.072	0.070
Development	0.075	0.077
Ore breaking	0.507	0.420
Scraping	0.241	0.206
Haulage	0.170	0.209
Underground General	0.077	0.070
Power	0.062	0.061
Total	1.204	1.113
% of cost	47.9%	46.3%
Concentrating		
Supervision	0.020	0.020
Primary crushing	0.059	0.060
Secondary crushing	0.161	0.161
Grinding and flotation	0.322	0.305
Reagents	0.185	0.207
Mill general	0.031	0.021
Power	0.149	0.147
Total	0.927	0.921
% of cost	36.9%	38.4%
Direct operating Assaying, engineering, office, insurance, camp and transportation	0.383	0.368
% of cost	15.2%	15.3%

of the methods fairly primitive in order to keep employment on the Navajo reservation high. Almost all the ore is moved from stopes in wheelbarrows.

At Wah Chang's Black Rock Tungsten Mine in California, total costs were $7.98 per ton in 1957 (Table 11 with labor accounting for 41.8% of the total.) During the first six months of 1957, production per contract man-shift averaged 17 tons and wages $32.

Other tables in this section represent mines that have made cost figures public. Tables 14, 15 and 16 are some large Canadian operations. Tables 17 through 24 are representative costs at Ontario gold and uranium mines.

Of course, the lowest cost underground mining method is still caving. Philip B. Buckey in *Mining by Block Caving*, 1945, wrote that block caving cost from 40¢ to 68¢ per ton (direct mining costs) with an average of 54¢. Forced caving figures were 30¢ to 79¢ per ton with a similar average of 54¢.

Mining costs in South Africa are remarkably low, especially when one considers that relatively small-sized equipment is used and that the mines are hot, wet and deep. Development costs average between $11.00 and $16.00 per ft for ordinary drifts and raises and several companies report total mining costs at about $1.00 per ton. Especially remarkable is the fact that many of these costs are approximately the same as in 1922, despite a tripling in the price of labor and supplies. Scientific management (industrial engineering, as we know it) came into vogue in South Africa in the 1930's and is credited with increasing productivity and keeping costs down.

The New Jersey Zinc Co. is a com-

Table 16, Gaspe Copper Mine Data, January to October 1958

	Orebodies B	C	B and C Combined
Total tons mined	340,900	1,176,990	1,517,890
Miner manshifts	9,156	27,234	36,390
Tons per miner manshifts	37.2	43.2	41.7
Maintenance manshifts			11,245
Total manshifts, miners and maintenance men			47,635
Tons per manshift, miners and maintenance men			31.9
Rock broken per foot of hole drilled, tons			1.04
Dynamite per ton broken, lb	0.73	0.48	0.54
Tons per 2½-cu yd shovel shift		1140	
Tons per 1½-cu yd shovel shift	608	704	675
*Equipment maintenance cost per ton, $			0.35
Equipment maintenance cost per ton, including replacement allowance, $			0.55

*25-% eventual reduction expected.
Source: Mining Engineering, Sept. 1959.

Table 17, Cost Per Ton Milled, Cochenour Willans Gold Mines Ltd.

	Total	1958	1957	1956
Development and exploration	$ 253,926.88	$ 3,363	$ 4,180	$ 4,167
Stope preparation (raising)	69,605.63	0.895	0.696	0.682
Mining	482,884.19	6.206	5.876	5.565
Milling	220,306.97	2.832	2.688	2.654
General mine expense	183,626.20	2,360	2.288	2.392
Head office expense	29,851.30	0.384	0.296	0.283
Marketing charges	18,232.14	0.234	0.235	0.196
Total Operating Costs	$1,258,433.31	$16.174	$16.259	$15.939
Deduct Estimate of Emergency Assistance				0.347
Net Operating Costs	$1,258,433.31	$16.174	$16.259	$15.592

Table 18, Costs at Delnite Mines Ltd.

	Total Costs	Cost Per Ton Milled 1958	Cost Per Ton Milled 1957	Cost Per Ounce Fine Gold Produced, 1958
Operating Costs (before cost-aid):				
Development and exploration	$ 35,998	$0.198	$ 0.875	$ 0.802
Mining	1,101,429	6.057	6.064	24.526
Milling	268,994	1.479	1.477	5.990
General mine charges after deducting sundry revenue	132,899	0.731	0.796	2.959
Administrative expense (partly mine)	52,148	0.287	0.346	1.161
Bullion marketing expense, including mint handling and refining charges	12,494	0.069	0.061	0.278
Total	$1,603,962	$8.821	$ 9.619	$35.716
Other Costs:				
Depreciation	$ 15,639	$0.086	$ 0.097	$ 0.348
Outside exploration	26,728	0.147	0.215	0.595
Shaft-sinking and development write-off	119,795	0.659	0.197	2.668
Total	$ 162,162	$0.892	$ 0.509	$ 3.611
Total Costs	$1,766,124	$9.713	$10.128	$39.327

Table 19, Costs at Hollinger Mine ($/ton) (Gold)

	1957	1958
Mining charges	$5.92	$5.58
Milling charges	0.88	0.81
General charges	1.23	1.04
Vacation pay, insurance and other employee benefits	0.50	0.47
Administrative charges	0.65	0.68
Total	$9.18	$8.58

Table 20, Costs at Ross Mine ($/ton) (Gold)

	1957	1958
Mining charges	$2.78	$2.77
Milling charges	1.96	1.90
General charges	0.84	0.82
Vacation pay, insurance and other employee benefits	0.25	0.23
Administrative charges	0.34	0.36
Total	$6.17	$6.08

pany that uses large underground equipment such as jumbos, Payloaders and Transloaders. In an article in MINING CONGRESS JOURNAL, December 1959, Johnson Crawford, assistant manager of mines, wrote that New Jersey's Zinc's rock breaking

Table 21, Costs at Kerr-Addison Gold Mines Ltd. (1958)

	Total	Per Ton
Development	$ 926,908.44	$0.558
Stope development	332.895.24	0.200
Mining	3,513,604.52	2.114
Haulage	545,466.73	0.328
Hoisting	361,556.06	0.217
General mine charges	1,991,199.69	1.198
Crushing and conveying	249,787.42	0.150
Milling	1,573,191.61	0.947
General expenses	739,055.61	0.445
Bullion marketing	135,749.29	0.082
Total operating cost at mine	$10,369,414.61	$6.239
Net operating profit at mine (before provision for depreciation, taxes, and head office expense)	$ 8,054,068.78	$4.846

cost averaged between 85¢ and 90¢ per crude ton and that loading costs averaged 36¢ per ton.

Table 22, Costs at Lake Shore Mines Ltd.

	Total 1958	Per Ton Milled 1958	Per Ton Milled 1957
Mine development	$ 147,462	$ 0.781	$ 0.899
Mining	1,418,891	7.517	7.384
Milling	392,718	2.080	2.234
Mine office and supervision	175,682	0.931	1.007
General expenses at the property	349,731	1,853	1,674
Administrative and corporate expenses	65,089	0.345	0.381
Total	$2,549,573	$13.507	$13.579

Table 23, Costs of Leitch Gold Mines Ltd.

	1958
Exploration and Development:	
Station cutting	$ 0.04
Crosscutting	0.05
Drifting	1.45
Raising	0.74
Underground diamond-drilling	0.02
Total	$ 2.30
Mining	12.71
Milling	4.62
Total operating cost at the mine	$19.63

Table 24, Summary of Development and Operating Costs, Consolidated Denison Mines Ltd. (1958) (Uranium)

	Per Ton Milled
Underground:	
Development	$ 3.02
Mining	2.38
Total	$ 5.40
Milling	4.17
Mine administration and general expense	1.20
Total	$10.77

Mine mechanization has helped to keep costs down in the eastern Tennessee zinc mines. Crawford wrote. "The trend of mechanization has been from mine rail to caterpillar trucks to rubber tired mounting, each with a resulting improvement in efficiencies and production costs. Present thinking is that rubber tired mounted loaders have gerater efficiency and lower maintenance costs. Most operators find that equipment mounted on steel caterpillar treads is expensive to maintain because of the absence of any cushioning from operating on the hard rock of mine floors. Now the Gismo has been put on rubber tires and with some other modifications is known as the Transloader. Small shovels, such as the Koehring scooper, are being used."

At the Cordero Mine, It's Bonus for Effort

J. ELDON GILBERT

THE NEED TO REDUCE LABOR COSTS and yet encourage production became an acute problem at Nevada's Cordero late in 1958. Situated in northern Nevada, the Cordero mine began operation in 1940, and since then has produced about 75,000 flasks of mercury. Typical of small mines of the West, there is a bunkhouse and boardinghouse for single men, and a small camp for families. Generating its own power, pumping its own water, mining and fu- acing the ore, the operation, somewhat isolated, is almost self-contained. Working at the operation in all categories are about 90 employees who handle some 4000 tons of ore per month to produce from 400 to 700 flasks of mercury per month.

During the period from 1955 to 1958 wages and other costs had increased materially but these had been offset somewhat by increasing efficiency in the mine and on the surface. A new shaft was sunk and put in operation. Also, by using better equipment than had been employed at the mine plant, and by using slusher pockets and other innovations underground, the hoisting bottleneck which previously existed was effectively removed.

In the past, the work week had been 48 hr, but in March 1958, it was reduced to 40 hr, making it necessary to pay overtime. During this same period, Cordero was in a mining district where there were at least 6 other mines of comparable or larger size, and miners eddied from mine to mine. As some left the district others moved in to replace them, and a more or less constant labor reservoir was maintained. Then in 1958, with no tungsten market, the other mines, which were principally tungsten producers had either shut down or had drastically curtailed their operations. The miners left the district and with none coming in to replace them Cordero became isolated with no labor force from which to draw. As men left the mine, replacing them became more and more difficult.

When the price of mercury began to decline, it became imperative that something be done to reduce the exodus of miners, to stimulate greater effort by the employee, and yet hold or, preferably, reduce costs. It was at this time, March 1, 1958, that the following bonus system was installed:

1. A base period was taken during which costs per ton of rock mined and ore milled was taken. For Cordero this was the last 10 months of 1958.

2. As operations continued, production costs (costs per ton) were taken every 3 months and compared to the base. If there had been a reduction in costs per ton, this figure was multiplied by tons handled and the product was declared a bonus.

3. The bonus was divided evenly, with 50% going to the company and 50% going to the eligible employees.

4. Eligible employees constituted all workers including the staff, who were working at the mining operation and who did not participate in other types of incentive payments, i.e., piece work or miners "gyppo." (The only exception was the assistant manager, who lived at the mine and was in charge of the entire operation).

5. Division of bonus to employees was on the basis proportioned to their regular wages or salary.

6. Bonus period was 3 months. At that time calculations for the bonus were made and paid separately from regular wages at a special bonus meeting.

In organizing the bonus calculations, it was decided to reward the employees when they increased tonnage production or cut costs. Because many of the costs pertinent to the mining operation were beyond their control to alter, these expenses were not included either in figuring costs for the base period or for subsequent bonus periods.

The costs included were the following: labor, supplies, materials, fringe benefits (Old Age benefits, Nevada Industrial payments, hospitalization, etc.), insurance, and depreciation. They did not include costs of outside exploration or development, administration costs, Federal taxes, State net proceeds of mine tax, and cost of marketing the product.

A comprehensive attempt was made to keep the tonnage calculations simple. No doubt the figures are greatly over-simplified, but they were used both in determining a base and for all bonus calculations. They are believed to give equitable results, at least at Cordero where they were developed. The figure actually used was

Mr. Gilbert is general manager of Cordero Mining Co. with headquarters at 131 University Avenue, Palo Alto, Calif.

called "adjusted tonnage," and was determined as follows:

Tons of ore or waste mined and hoisted multiplied by 2. (Mining costs or roughly double milling costs)

Tons of ore from pit multiplied by ⅔. (Small pit mining at Cordero costs ⅓ underground mining)

Tons of ore furnace multiplied by 1.

Total of above divided by 3 gives "adjusted tons."

While the formula may sound like gibberish, an example will help explain it:

Tons of ore mined	4000 x 2	=	8000
Tons of waste mined	500 x 2	=	1000
Tons of pit ore	500 x 2.5	=	200
Tons milled	4300 x 1	=	4300
Total			13500

13,500 ÷ 3 = 4500 adjusted tons

If we continue with this example, the entire procedure becomes clear. Let us say that the total cost at the mining operation which is to be used for bonus determination is $78,750 for one month. This figure divided by 4500 adjusted tons gives us $17.50 as our cost per ton. Now, if our cost per ton during the base was $20, there is a saving of $2.50 per ton. This $2.50 multiplied by the 4500 adjusted tons gives $11,250 as total bonus; 50% of this is retained by the company as its portion and the other 50% ($5625) is paid out to the employees as bonus. If the total of wages and salaries of all employees who are participating in the bonus is $28,125, then each employee will be entitled to 20% of his basic wage as a bonus for the month. At the end of each month the bonus figure is calculated and announced to the participants, but is not paid. The total bonus is recalculated for the full 3 month bonus period and then paid. The average for the period may be above or below any single month.

No information was found to help guide the management in this particular type of bonus system, so it was put into operation with a feeling of trepidation. Some of the particular problems and how they worked out included:

Can grade of ore be controlled when tonnage is encouraged?

There has been no problem with the grade of ore within the limits of the mine. Since nearly all underground mining is square-set mining, it is fairly simple to select the sets to be mined. Even on the surface, where mining is done by a small power shovel, there has been excellent cooperation between the shovel operator and the foreman for the general good of the operation.

What is a simple method of paying a production bonus which will satisfy the requirements of United States Wage and Hours?

By paying all bonuses in direct proportion to the basic wages earned, it follows that if any overtime is worked and paid for at 1½ basic rate, then the bonus is also paid at this same rate.

Who should participate in such a bonus?

After careful consideration it was decided that all personnel at the operation who contributed to production directly or indirectly or could reduce costs should be included. Men working on piece work, such as churn drill operators, where pay is on footage drilled, and miners working on the typical miners "gyppo," where payment is a form of piece work, were not included. However, if their time was split between work on "gyppos" and company time, they participated for the company time. Also, the assistant manager acting as resident manager did not participate, and remained outside the system. He was thus entirely free to administer it without a question of conflict of interest. Office personnel, cooks, furnace operators, truck drivers, and all surface and underground workmen were included. However, if a crew was used to do some type of experimental work where no immediate cost savings were made or production resulted. these men would not be included. An example would be a detailed geophysical survey.

A man must be on the payroll for one full month and must still be on at the 25th of the month following the bonus period in order to participate. Should he be terminated for any reason during the bonus period, his portion of the bonus goes into the general bonus pool. Should his termination occur between the end of the bonus period and the 25th (bonus pay day) of the following month, then his check is returned to the company. This overlapping of bonus periods by nearly one month tends to discourage men from leaving at the end of one bonus period, for by then they are well into the next period.

How will savings be made?

During the first period there was some feeling of suspicion on the part of the employees. Would the company pay if a bonus were earned, or would it come up with a "fine print" clause in order to get out of paying? Of course, the company paid willingly. As a consequence, the program became a more serious matter and more effort was made to make it operate. Production was increased. Not only the miners and muckers but also trammers, skiptenders, and hoistmen found it easier to get out a few extra tons.

Foremen and shiftbosses did not postpone essential but sometimes disagreeable tasks, as had occasionally been their wont. If employees did not perform, dismissal came quickly because every drone had at least one finger in his foreman's pocket. When a new man was hired the foreman made doubly sure he would work. The spoils were split up among the "survivors," and the fewer men the bigger the split.

Equipment was handled with extra care, and a broken machine became more than an excuse to sit and smoke until after the shifter came by. Supplies became something of value, to be used sparingly, recovered, and used again if possible. Every economic phase of the operation became the concern of every man.

Of course, the big question is—will it have the desired results?

The program has been in operation for two full years, eight bonus periods, and during that time a bonus was paid for seven of the periods. The single period when no bonus was paid was one during which a fire completely destroyed the powerhouse with all generating equipment, compressors, Diesel engines, and machine shop. Naturally, this accident curtailed production.

During these seven periods the smallest amount paid was 13½%, the largest 25%, and the average of all eight periods was 17%. Therefore, if a man was normally earning $400 per month he received every three months an additional $200, and once as much as $300.

The overall effects have been most gratifying. General morale of the personnel has greatly improved. Labor turnover, which has been a major problem since the mine began operation, is now reduced to practically zero. The mechanical functioning of all parts of the operation has markedly improved. Costs per unit production, which had been climbing steadily and were threatening to keep going up, actually have been reduced. At Cordero stimulating and rewarding extra effort is paying off.

Mineral Processing Costs— Interesting But Little Talked About

VERY FEW COMPANIES are willing to talk very much about their mineral processing costs. And the few who are willing do so only in confidence.

From the businessman's point of view, this is understandable. Many cost data are among the type of data that are considered best kept confidential. But companies' reticence makes it hard for those who want to find facts about what various processes actually do cost.

You'll see on these pages a few tables of actual cost data that were submitted in confidence to E&MJ. To protect the identity of those who made these data available, we've deleted their names and details of their operations which would make them readily identifiable. But the costs are actual figures, and they tell you accurately what some mineral processors have had to pay to run their plants.

Here are costs-per-ton achieved over several years by a U. S. lead-zinc producer.

Item	1953	1954	1955	1956
Drilling Expense	.26	.15	.09	.23
Development, surface	.25	.25	.19	.09
Development, subsurface	.05	.20	.30	.21
Mining:				
Breaking	.58	.61	.66	.65
Loading	.23	.27	.29	.32
Underground haulage	.27	.31	.31	.40
Hoisting	.07	.11	.14	.13
Pumping	.01	.04	.07	.05
Mine power	.17	.19	.20	.18
Mine maintenance	.40	.26	.23	.26
Misc. mine	.23	.24	.27	.26
Total Mining	1.95	2.03	2.16	2.25
Grizzly screening	.09	.10	.11	.10
Surface transportation, ore	.07	.07	.07	.07
Milling:				
Primary crusher	.03	.03	.03	.03
Secondary crusher	.03	.07	.03	.03
Conveying & screening	.06	.06	.09	.09
Sampling	.01	.02	.02	.02
Ball mill grinding	.11	.17	.13	.15
Concentrating	.24	.26	.28	.27
Concentrate regrinding	.04	.02	.03	.09
Thickening & filtering	.05	.06	.07	.06
Mill power	.21	.22	.18	.17
Concentrate loading	.01	.02	.02	.02
Mill maintenance	.23	.19	.14	.12
Tailings disposal	.03	.03	.06	.06
Misc. mill	.25	.30	.35	.33
Total milling	1.29	1.45	1.43	1.44
Storehouse & protection	.13	.13	.13	.14
Admin: engineering, office, sanitary, etc.	.57	.62	.65	.59
Total rock ton cost	4.65	4.99	5.12	5.07
Payroll labor cost per ton	1.89	1.87	2.01	1.90

Figures that follow are for a base-metal mill whose ore contains gold values. Mill capacity is 75 tph. In the first 11 months of 1960, it processed 396,000 tons of ore; in November, 37,000 tons.

November 1960	Operating	Repair, Maintenance & Cleanup	Total
Labor:			
Surface crushing plant	$ 765	$1,024	$1,789
Rod milling	571	154	725
Ball milling	575	237	812
Flotation	1,337	759	2,096
Thickening & filtering	588	290	878
Concentrate loading			601
Tailings disposal			89
Mill supervision			2,850
Gravity concentration	246	97	343
Mill electrical			19
			$10,202
Supplies:			
Surface crushing plant		$1,889	$1,889
Rod milling	$3,407		3,407
Ball milling	5,891	123	6,014
Flotation	13,912	339	14,251
Thickening & filtering		841	841
Tailings disposal			(77)
Gravity concentration		166	166
Mill electrical			197
			$26,688
Power:			
Surface crushing plant			$ 514
Rod milling			1,357
Ball milling			2,043
Flotation			2,377
Thickening & filtering			649
Concentrate loading			11
			$6,951
Month total, direct:			$43,841

Direct costs:	Nov. '60	Yr to 11/60	Per ton, yr
Surface Crushing plant	$4,192	$42,779	$ .11
Rod Milling	5,488	67,669	.17
Ball milling	8,869	90,558	.23
Flotation	18,724	252,352	.63
Thickening & filtering	2,368	20,985	.05
Concentrate loading	612	8,429	.02
Tailings disposal	12	10,511	.03
Mill supervision	2,850	26,727	.07
Gravity concentration	509	7,040	.02
Mill electrical	217	2,112	.00
Total Direct Costs	$43,842	$529,163	$1.33
Indirect & Overhead	1,885	25,967	.07
	$45,727	$555,130	$1.40

Supplies, detail		Nov. '60	Yr to 11/30	Per ton, yr
Rod milling:	Liners	—	$8,215	$ .02
	Rods	$3,407	36,356	.09
Ball milling:	Liners	1,556	10,037	.03
	Balls	4,335	44,568	.11
Flotation:	Reagents	13,912	187,665	.47

Major Cost Elements Include Labor, Reagents

Mining and milling cost breakdown for a Western base metal producer, year 1960.

Item	% of total	Cost/ton	Total
Mining			
Labor	53.0	$4.62	$1,112,774
Explosives	3.7	.33	78,537
Timber	7.0	.61	147,531
Misc. supplies	12.6	1.10	264,567
Power	4.7	.41	98,171
Sundry	1.7	.15	35,860
Indirect	14.7	1.28	308,502
Depreciation	2.6	.23	55,622
	100.0	8.73	2,101,564
Milling			
Labor	24.1	$ .70	$ 169,598
Balls	7.5	.22	52,969
Liners	1.6	.04	10,938
Reagents	19.7	.58	138,696
Misc. supplies	13.3	.39	93,666
Power	10.8	.32	76,149
Sundry	6.3	.18	44,498
Indirect	9.5	.28	66,549
Depreciation	7.2	.21	50,341
	100.0	2.92	703,404

Milling costs, breakdown by items & operations

Item	1960	1959	1958	Avg 1946-48
Labor	$ .70	$ .72	$ .62	$ .65
Grinding: Balls	.22	.23	.21	.13
Liners	.04	.08	.05	.06
Reagents	.57	.67	.71	.29
Supplies, general	.39	.36	.23	.32
Power	.32	.32	.32	.39
Water	.03	.03	.05	.05
Trucking concts	.15	.15	.14	.11
Miscellaneous	.01	—	—	.01
Indirect	.28	.32	.25	.22
Depreciation	.21	.20	.18	.20
	2.92	3.10	2.76	2.43

Operation	1960	1959	1958	Avg 1946-48
Crushing	$ .21	$ .15	$ .14	$ .19
Grinding	.44	.55	.44	.34
Flotation	.61	.79	.78	.47
Cyaniding	.24	.24	.22	.01
Gen. mill expense (see below)	.93	.84	.75	1.01
Indirect	.28	.33	.25	.24
Depreciation	.21	.20	.18	.21
	2.92	3.10	2.76	2.47
General mill expenses:				
Tailings disposal	.05	.02	.03	.07
Power	.32	.32	.32	.40
Water	.13	.08	.05	.06
Super. & office	.06	.08	.06	.10
Gen. Repair & Mtce	.15	.14	.10	.08
Miscellaneous	.05	.03	.03	.20
Hauling & Loading Concts.	.17	.17	.16	.10
	.93	.84	.75	1.01

Operations for a Western base-metal producer with high silver values produced the following costs for the year 1960:

Operation	% of total Labor	% of total Other	Total	per ton
Crushing	11.0%	0.7%	11.7%	$ .15
Grinding	9.1	20.7	29.8	.37
Flotation	15.0	9.8	24.8	.31
Concentrate hauling	3.9		3.9	.05
Tailings disposal		3.9	3.9	.05
Repair & Maintenance				
Crushing	2.8	4.7	7.5	.09
Grinding	4.1	2.0	6.1	.08
Flotation	3.8	2.2	6.0	.08
Miscellaneous	4.0	2.3	6.3	.08
Total	53.7%	46.3%	100.0%	1.25
Per ton	$0.67	$0.58		

Milling costs for a typical month of 1960, a medium-tonnage base-metal mill

Operation	Cost/ton
Crushing	
Operating	$ .09
Repairs	.18
	.27
Grinding	
Operating	.10
Balls	.20
Liners	.06
Repairs: Mill	.05
Cyclone	.02
	.43
Flotation	
Operating	.10
Reagent	.36
Repairs: Flot. machines	.07
Filters	.03
Thickener	.00
	.56
Cyaniding	
Operating	.08
Reagent	.12
Repairs	.01
	.21
General mill expense	
Tailings disposal	.01
Power	.39
Water	.15
Super. & office	.08
Hauling & loading concts.	.15
Conveyors & tripper	.01
Vacation allowance	.03
Gen'l M&R	.16
	.98
Total Direct	$2.44
Indirect expenses	
General expense	$ .18
Group insurance	.01
Fire insurance	.01
Liability insurance	(.20)
O. D. insurance	.00
Property tax	.02
Depreciation	.21
	$ .23
TOTAL DIRECT & INDIRECT EXPENSE:	$2.67

Flotation Costs Vary Widely

Interested in costs of flotation? Here, courtesy of American Cyanamid Co., are some results of a study recently completed by F. W. Bloecher Jr. of that company's mining chemicals dept.

Equipment Costs

Typical costs (August, 1960) are shown in Table 1 for a 4-cell bank of the three most widely-used flotation machines in sulphide, coal, and nonmetallic flotation operations in the western hemisphere. These units are the largest made by each manufacturer.

Plant Costs

Froth flotation plants will generally be completely integrated concentrating operations, with equipment also installed for crushing, grinding, sizing, materials handling and perhaps water recovery. Hence, the actual cost of the flotation section of a milling plant will be a small part of the overall capital cost. Large sulphide mills (2000 tpd and up) will cost approximately $2,000 per tpd (August, 1960). Smaller plants will run higher than this. This approximation allows for a complete milling installation with wiring, piping, auxiliaries, ore bins, and mill water tank, but no shops or warehouses. Of the $2,000 tpd total, about $20/tpd is the cost of flotation equipment alone in larger mills. In small mills (100-500 tpd) total cost may run as high as $3,000-4,000/tpd, with flotation machines running to $60/tpd. The largest item in mill capital costs will usually be crushing and grinding equipment. Some smaller flotation mills have reportedly been built for as little as $1,000/tpd, but these have a minimum of auxiliary equipment and services, and often use second-hand equipment.

Important variables influencing total cost of a flotation mill are: (1) hardness of ore and mineralogical associations (these determine ease and fineness of grinding); (2) metal content of ore (nonmetallics require much greater materials-handling investment for concentrates than do base-metal sulphides, for example); (3) soil conditions at mill site; (4) weather conditions; (5) estimated life of plant; (6) degree of automation; (7) type of construction required or preferred; (8) safety factor for capacity.

To get a rough estimated maximum cost of a sulphide concentrating plant, a rule of thumb used by some engineering companies is to multiply the total mill equipment cost (fob factory) by four. This is for a deluxe plant. Less elaborate mills may cost three times fob-factory cost of equipment.

Power Requirements

Power consumption for most sulphide ores will range from 2 to 3 kwh per ton of feed (for flotation alone). Easy-to-float ores such as the well-deslimed Florida phosphate ores can be floated for about 1 kwh/ton. A typical copper-sulphide ore will require 2½-3 kwh/ton.

Chief factors influencing power requirements are: (1) amount of cleaning done, (2) pulp density (dilution) of feed, (3), flotation time, and (4) froth and middling pumping requirements.

Labor Requirements

In modern sulphide flotation plants one operator can readily handle flotation sections treating up to 12,000 to 14,000 tpd of feed, provided ore is not too complex and treatment is fairly simple. In some new coal flotation operations, incorporation of a flotation circuit for fines recovery has been made in an existing preparation plant without addition of any extra manpower. Machines run automatically with a brief check several times a day. An average labor requirement (first half of 1960) for large porphyry copper-sulphide concentrators is one man-shift per 800 tons of ore, including maintenance and repair.

(*Continued on p 240*)

Table I—Typical Flotation Machine Costs (August, 1960) for 4-Cell Bank

Type, Size	Pulp Volume, Cu Ft: Per Cell	Pulp Volume, Cu Ft: Total	Total Installed HP	Fob Factory: Total	Fob Factory: Per Cu Ft Cell Vol.	Remarks
Fagergren 66 in.	61	244	40 (Range 40–60)	$7,600	$31.15	Mild steel construction with rubber wearing parts. Excludes froth launders, includes boxing, tankage, four 10-hp motors and drives.
Denver Sub-A 56 in.	100	400	40 (Range 40–50)	$10,018	$25.05	Mild steel construction with molded rubber wearing parts. Includes two 20-hp motors and drives, ⅓-hp paddle shaft drive, supercharged air header but no blower. Free-flow type, no intermediate weirs.
Agitair 48 in.	40	160	30 (Range 20–30)	$5,418	$33.86	Mild steel construction with rubber-covered wearing parts. Includes two 15-hp motors and drives, excludes feed box, junction box and blower.

AGITAIR Flotation is a registered trademark of The Galigher Co. Sub-A machines are sold by the Denver Equipment Co. and Fagergren machines by Western Machinery Co.

Phosphate rock processing costs, a Florida producer:

Grinding (50% minus-200-mesh)	$0.85/ton
Flotation	.40
Drying (2% moisture)	.39
Washing & sizing	.14/cu yd

Bauxite drying costs, average $0.55-.75/ton

Here are combined mining and milling costs for a medium-tonnage western gold producer. Mining was open-pit and reclamation of a low-grade dump. Mill is an all-slime 400-tpd CCD cyanide plant.

Year	Tons milled	Total expenses*	Cost per ton
1959	89,200	$290,500	$3.26
1960	88,900	306,300	3.45

*Includes depreciation and small amount of development work.

Modern Materials Handling—Vital to

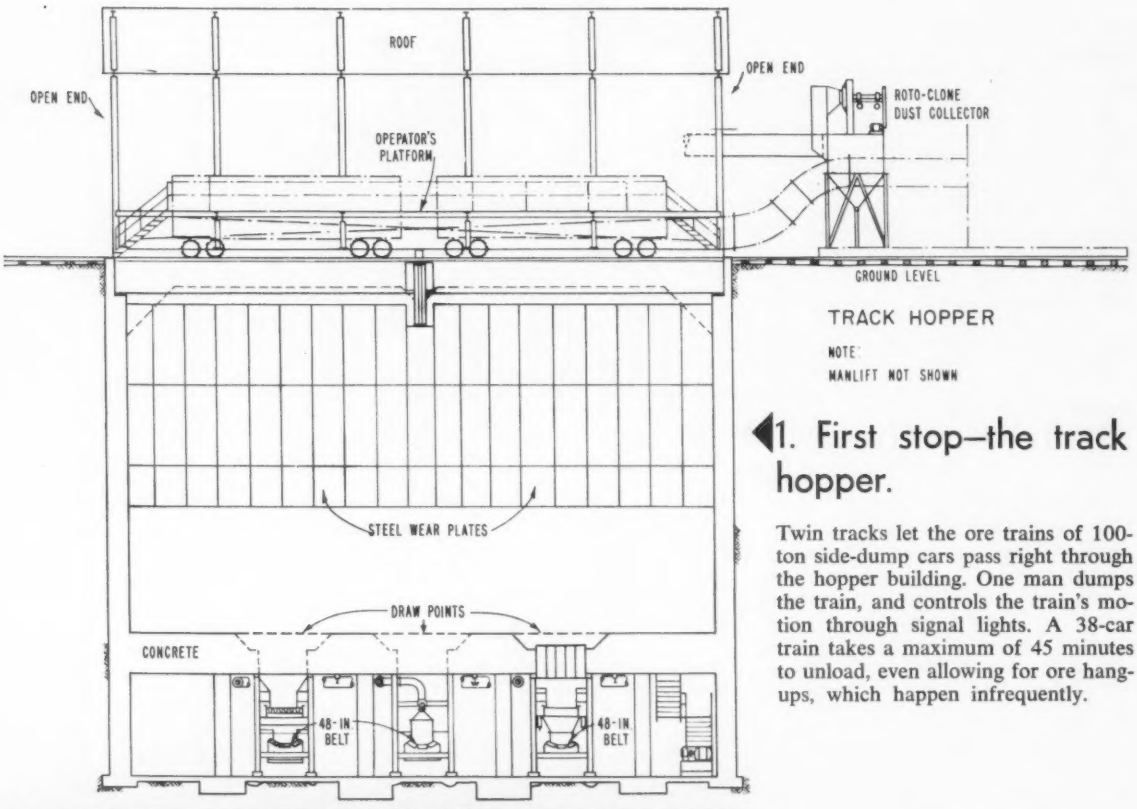
HERE'S A FINE EXAMPLE of one of the most up-to-date materials handling systems—Kennecott's newly-expanded 22,500-tpd grinding-and-flotation mill at Hayden, Ariz. (E&MJ, March 1961).

By efficient design, such as that shown here, you:

—Keep down the number of men needed to operate the system;

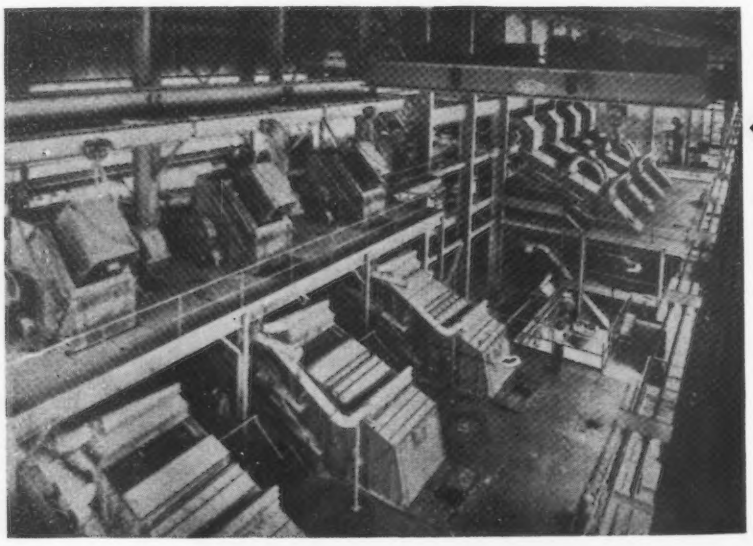
—Keep the system under closer control;

—Get the most in production for your investment and operating dollar. It adds up to: keeping your operating costs down!



1. First stop—the track hopper.

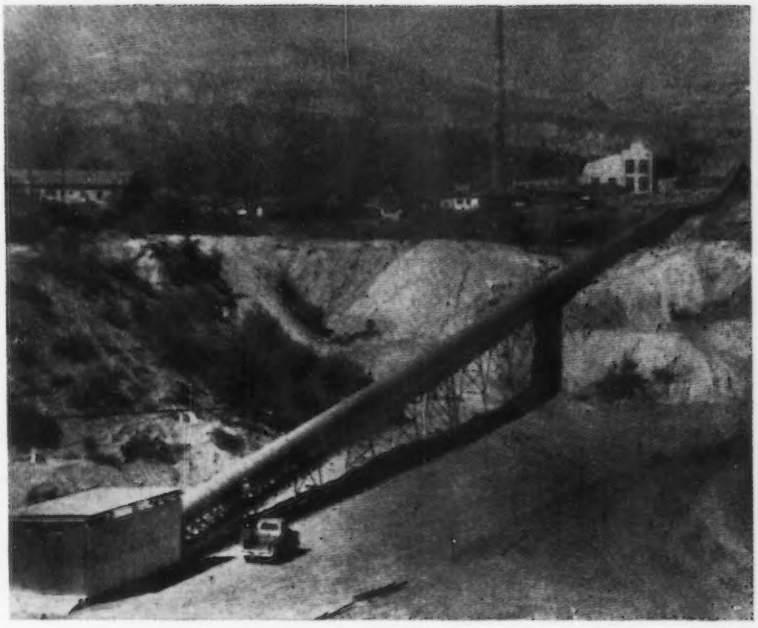
Twin tracks let the ore trains of 100-ton side-dump cars pass right through the hopper building. One man dumps the train, and controls the train's motion through signal lights. A 38-car train takes a maximum of 45 minutes to unload, even allowing for ore hang-ups, which happen infrequently.



2. Three 500-tph belts draw . . .

the 10-in. material from the track hopper, send it directly to the secondary and tertiary crushing sections (left). When the three standard and four short-head 7-ft cone crushers have worked it over, it's down to minus-½-in., and ready for the mill.

Low Operating Costs

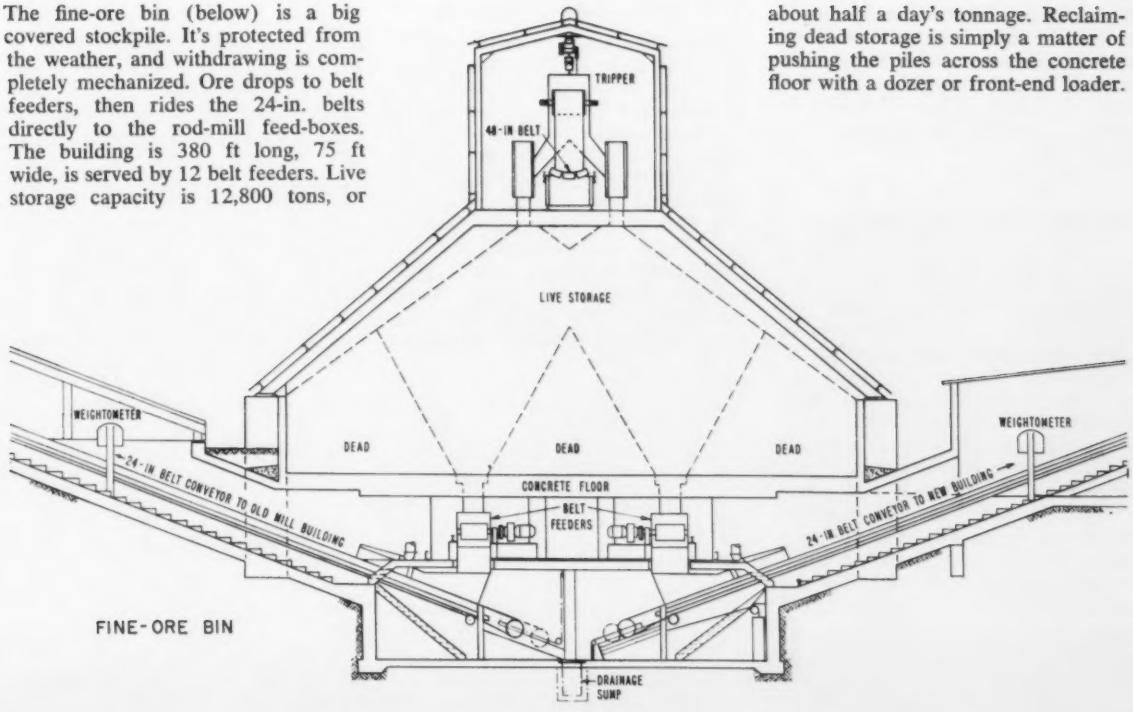


3. A single 42-in. belt conveyor . . .

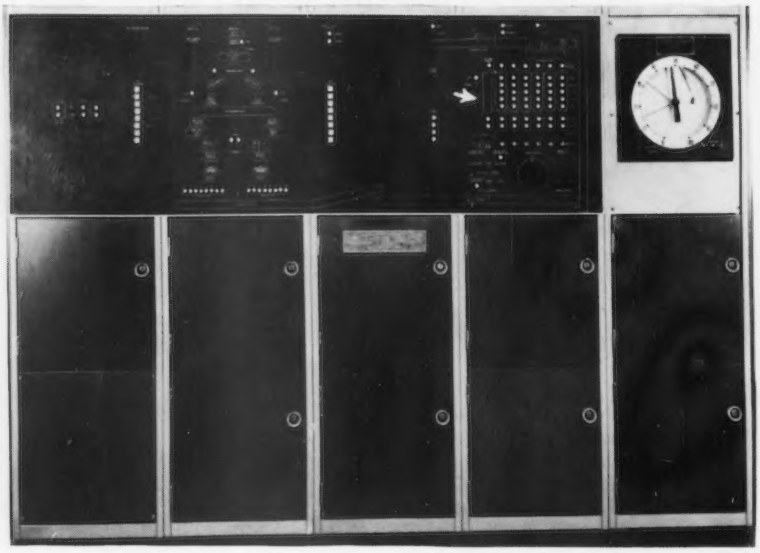
lifts the whole crusher output (up to 1600 tph) up to the mill site, 200 ft higher and nearly half a mile away. The operator in the crusher keeps track of the whole ore-handling operation. His panel board has indicating lights and pushbutton controls for all belts and feeders. Weightometers tell him how much material is flowing over the belts. An efficient alarm and interlock system guards the various belt transfer points, and pinpoints immediately any trouble that develops.

4. Last stop before the mill.

The fine-ore bin (below) is a big covered stockpile. It's protected from the weather, and withdrawing is completely mechanized. Ore drops to belt feeders, then rides the 24-in. belts directly to the rod-mill feed-boxes. The building is 380 ft long, 75 ft wide, is served by 12 belt feeders. Live storage capacity is 12,800 tons, or about half a day's tonnage. Reclaiming dead storage is simply a matter of pushing the piles across the concrete floor with a dozer or front-end loader.



2 Operators Control All Ore Handling At Anaconda Plant



LOOK CAREFULLY at these two control boards, for sampling and feeding storage bins (above) and for removing ore from storage and transferring it to mill bins (right). Operator has at a glance before him a constant picture of the ore-handling operation. Notice particularly the bin-level indicators (arrows). At all times he knows

WHEN ANACONDA CO. recently modernized its reduction works at Anaconda, Mont., its engineers decided to automate the materials handling system that moves ore from the car-dump through the crushing plant and to the mill. They did so, and here is a measure of how successful they were: two men (and one maintenance and clean-up man) operate the system that handles roughly 2500 tph of ore (40,000 tons per day).

This modern attack on the problem of high operating costs was carried out by Anaconda in conjunction with Industrial Physics & Electronics Co., Salt Lake City, which furnished the automation system. Mr. C. M. Marquardt of IP&E reported on it in a paper* recently published by the American Society of Mechanical Engineers, of which this is a digest. The paper will be presented at the ASME summer meeting, Los Angeles, June 11-15, 1961.

Different Ores Are Blended

Three types of copper ore from Butte are processed at Anaconda. The Berkeley pit produces the most; the Kelly shaft, a block-caving mine, yields next most; and miscellaneous deep shafts, working in high-grade ore, contribute some. Before modernization, each of these ore types required its own mill section. There are also manganese and zinc ores, which are treated in separate plants.

Anaconda's engineers decided that the copper ores could be treated in a single grinding and flotation circuit by blending and proportioning the separate ores. They decided to install six 3500-ton storage bins for all copper ores. Drawing simultaneously from the separate bins they could preblend the mill feed. Installed between the crushing plant and the mill-feed bins, the storage bins also gave needed surge capacity.

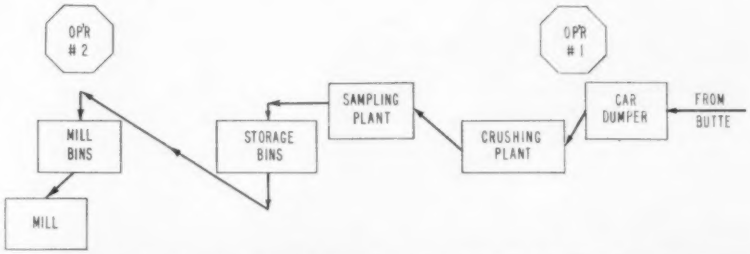
System Divided in 2 Parts

The materials-handling operation was broken down into two phases. First was placing the ores from the crushing plant in storage, and sampling them as they went in. One operator now controls this phase from a station in the car-dumping tower. The second phase is removing the ores from storage (blending them in the process) and delivering them to the mill bins. A second operator controls this phase from a station in the mill bin area. The storage bins are located about ¼ mile from the dumping tower and the mill bins about ¾ mile from the storage bins.

At each of the several transfer points in the belt system, a man had been stationed round-the-clock to guard against plug-ups.

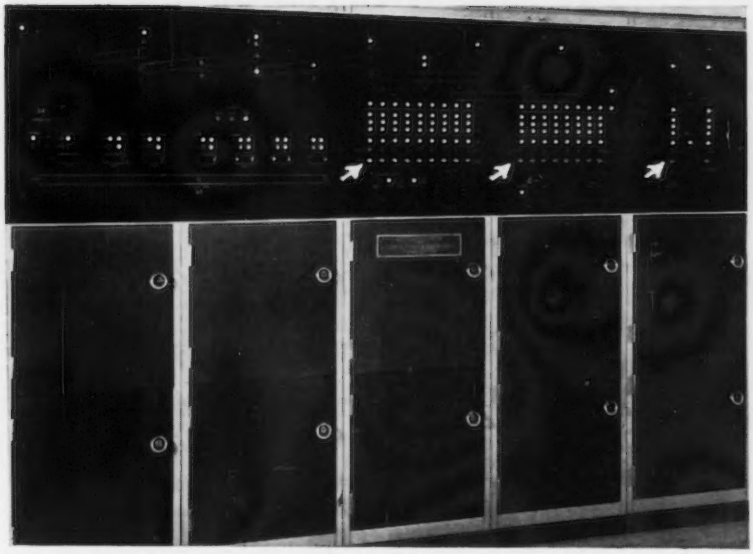
Before automating the system, Industrial Physics & Electronics Co., cooperating with Anaconda, developed a "Transist-O-Trol" probe switch, which can detect material level at belt junctions or in bins. A transistorized probe, rather than the more fragile vacuum-tube type, was needed because of high vibration levels.

Transist-O-Trols now monitor each belt junction and each of the six storage bins and 19 mill bins. Through indicating lights, they inform the operator whether a storage bin is full, ¾ full, ½ full, ¼ full or empty. For mill bins they indicate full, ⅔ full, ⅓ full and empty. Look care-



TWO OPERATORS, one at car-dumping tower, the other in mill bin area, between them control all of Anaconda mill's ores coming from mines at Butte.

*"The Automation of a 40,000 Ton Per Day Ore-Handling Facility," by C. M. Marquardt, Industrial Physics and Electronics Co., Salt Lake City, Utah. Paper published by the American Society of Mechanical Engineers, New York, N.Y. Material for this summary courtesy of ASME.



the condition of six 3500-ton storage bins (left), nineteen 1000-ton mill feed bins (above). You also see outlines of all conveyors, including the two shuttle conveyors. "Start" control for a belt is in the head pulley, "stop" control in tail pulley; "emergency stop" is button in middle of the belt.

fully at the photographs of the control panels, and you will see the bin indicator lights (arrows). The operator's job is made easy by "Gravoflex" sketching of equipment outlines on the panel. Notice this in the photos also.

Normal practice is to let the shuttle belt over the storage bins fill one bin at a time. Three bins are ordinarily assigned to Berkeley pit production, two to the Kelly shaft, and one to the remaining ores. Drawing simultaneously from all bins thus produces a blended fill feed.

The sampling scheme was so set up that it would automatically place the sample in the proper sample can for each of the ores. Each is sampled once a day. When a particular ore arrangement has been set up on a "patch" panel, merely pressing a single selector switch for the particular ore involved sets up both the bin arrangement and the sampling arrangement for that ore.

Magnetic proximity switches detect and control the position of the shuttle car. They are very reliable and immune to water, dust and other contaminants.

Protecting the Belts

Belt misalignment switches and zero-speed switches were installed to detect broken belts. Because of its heavy load, the shuttle belt over the storage bins needed some protection against reversal of its direction while loaded. A belt weigher near the head pulley of the belt feeding the shuttle furnishes this protection. The shuttle conveyor can be reversed only when this weigher has shown zero load for a period of one minute.

The 365-ft-long shuttle belt over the mill bins is protected in a similar way. To reverse this belt, the operator shuts down the feeders under the storage bins for a 3-minute period. After a 9-minute transportation lag, this 3-minute "feed-break" arrives at the belt scale just before the shuttle belt. When it arrives, the scale automatically sets up a 1-minute timing circuit to guarantee clearance of all ore from the shuttle belt. At the end of the minute, a flashing light on the control panel signals "o.k. to reverse shuttle," and the belt can be reversed. At the end of the 3-minute break, the feeders under the storage bins start again automatically.

At both sets of bins, "lock-out" protection is provided. When men are working in a bin for repairs or other purposes, the bin top is boarded over to safeguard them. It's imperative that the shuttle not discharge to such a bin, so lock-out circuits were provided to prevent it from doing so.

Even the dust collector system at the mill bins was automated. Only at the bin being filled is the damper to the dust-collection piping open. Dampers at all other bins automatically remain closed.

An ingenious automatic method deals with hang-ups in the mill bins, which occur from time to time with moist ores. When a hang-up or "chimney" occurs, the belt feeder drawing from the bin runs empty, though the bin itself may be nearly full. A Transist-O-Trol probe near the feeder tail-pulley senses when the feeder is not drawing ore, and actuates a system of "shot-guns" —2½-in. air lines entering the bin about 15 ft above the discharge point — to knock down the ore. Air at mill pressure, 90 psi, is allowed to escape for a very short period through electrically controlled valves. Four guns are located at 90° around each bin, and are blasted in cyclic order.

Should the gunning fail to break the ore loose in one minute, warnings are sounded both at the operator's control panel and on the rod-mill floor, and the feeder shuts down. This safeguard is both to prevent the large dust evolution when the bin eventually slumps and to protect against loss of feed to the rod mill.

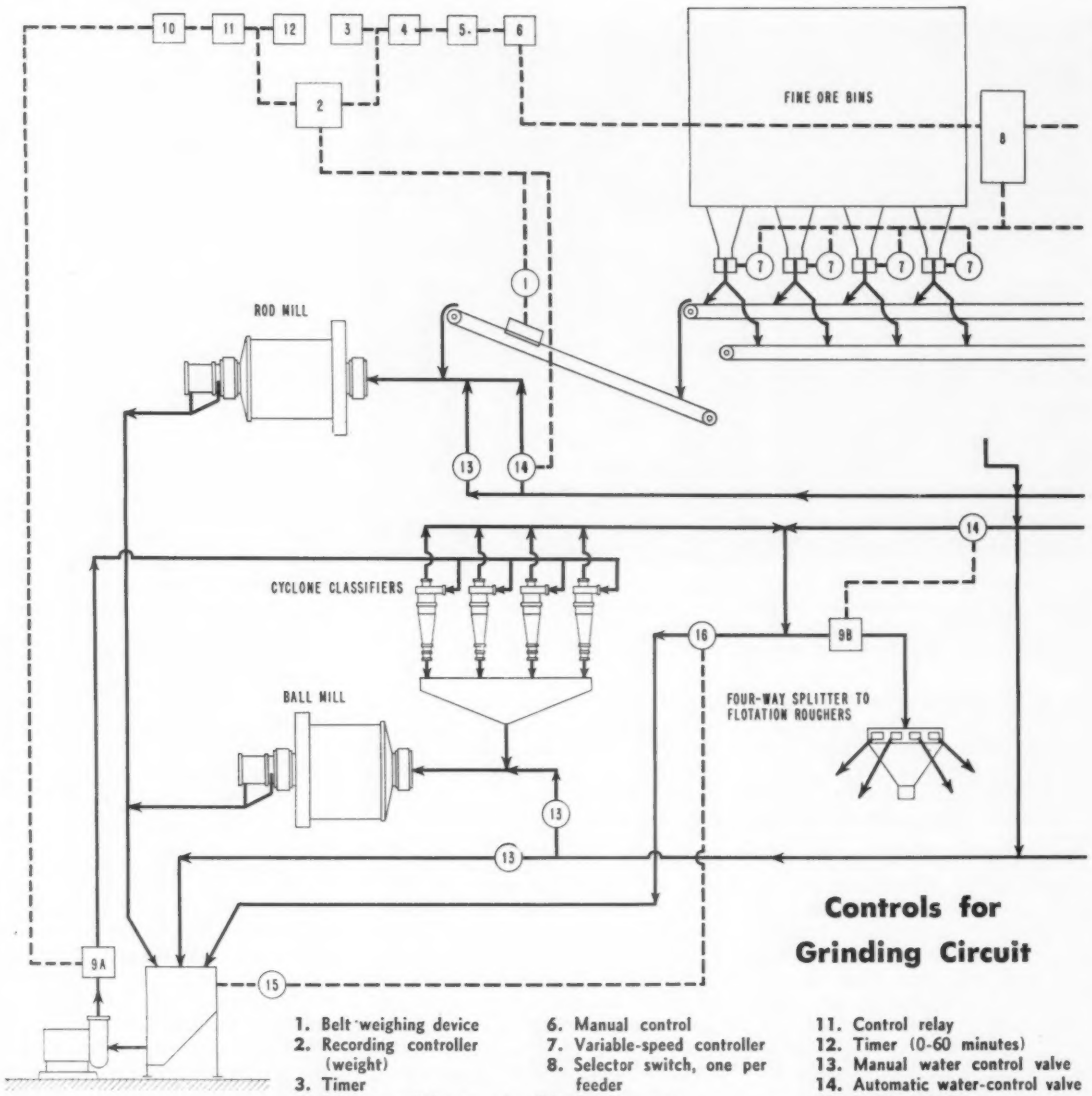
The system of Transist-O-Trols protecting the belt transfer points is so set up that when a junction point plugs up and trips out, the belts can only be started again by having a man inspect the trouble visually and reset the circuit at the point. Belts are thus guarded from inadvertent starts by the operator.

Handling Zn and Mn Ores

Zinc and manganese ores are handled by the conveyor system but bypass the storage bins. Such ores are passed through the crushing plant and sampling system, but then delivered directly to separate bins at the mill. When these ores are to be handled, the two operators confer by telephone and set up their schedule. The whole system is so interlocked that the zinc or manganese selector switches at the tower panel will not be operative unless the shuttle belt over the mill bins is in proper position to drop zinc or manganese ores into their proper bins.

Anaconda won't tell you how much it costs to operate their new system. But it's a safe bet that it's pretty cheap. And the benefits are felt all the way down the line in the mill, in the form of a uniform, steady mill feed under close control at all times.

The sampling and storage system gives the operator accurate knowledge of how much of what is in each bin at all times. Armed with this knowledge, the company can intelligently plan its production from the mines and in the mill to give steady, efficient production. It all adds up to operating at lowest cost.

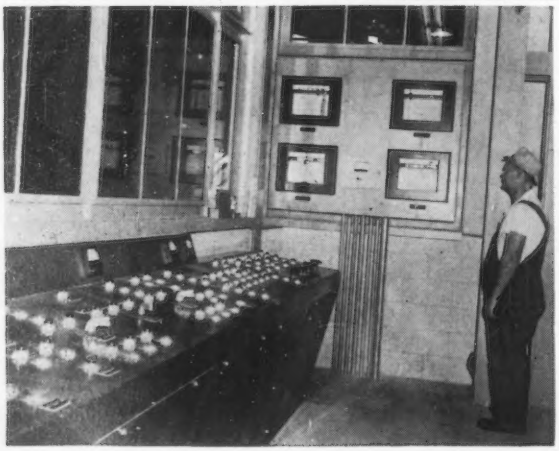


Controls for Grinding Circuit

1. Belt-weighing device
2. Recording controller (weight)
3. Timer
4. Selector switch, manual or automatic
5. Control relay
6. Manual control
7. Variable-speed controller
8. Selector switch, one per feeder

9A. Density gage
9B. Density gage

10. Density recording controller
11. Control relay
12. Timer (0-60 minutes)
13. Manual water control valve
14. Automatic water-control valve
15. Level controller
16. By-pass control valve



Instruments Do Most of the Work in This Grinding Mill

ST. JOSEPH LEAD CO'S VIBURNUM MILL comes as close to being the "push-button mill" as you're likely to find. Here's the grinding circuit (control room is seen at left). Solid lines indicate flow of material; dotted lines indicate flow of measurement or control signals. Each numbered item is a unit in the measuring, recording, and controlling system that makes the operator's job easy and gives most-efficient operation at all times. Properly maintained, this system should give rock-bottom milling costs.

For the full story of St. Joe's new project at Viburnum, see E&MJ January 1961.

What Does Maintenance Cost?

A tough problem for the designer or operator is estimating the future maintenance cost of equipment. Unless he knows or can learn at first hand how much similar equipment has cost to maintain, he may find information for estimating hard to comeby.

This article is excerpted from "Cost Engineering in the Process Industries" (Cecil Chilton, editor), a 475-page volume published in 1960 by McGraw-Hill Book Co. Though written for chemical engineers, it will interest many plant metallurgists because much of the equipment discussed is found in metallurgical plants. Cost figures here, which were accurate in 1951 when the article first appeared in CHEMICAL ENGINEERING magazine, may be brought up to date by referring to the cost index on p 182.

JACKSON D. LEONARD

ONE OF THE MOST PERPLEXING PROBLEMS facing the chemical engineer is the accurate estimation of maintenance costs. When preparing manufacturing cost estimates for new products, or even for an existing product using a changed or modified process, maintenance cost is the most difficult factor to predict.

At first glance, estimation of maintenance costs appears to be quite simple. All you do is assume that annual maintenance costs will amount to a certain percentage of your plant investment. The problem then becomes one of deciding what percentage to use. But this percentage factor might be as low as 1 percent or as high as 15-20 percent.

Suppose, too, that you add plant investment in the way of corrosion-resistant alloys, mechanical shaft seals, extra manholes and handholes, etc., in order to reduce the cost of repairs and replacements. This added investment will reduce maintenance costs. But if you are estimating maintenance costs as a percentage factor on investment, you are obviously working in the wrong direction.

In developing a more direct approach to the problem, we run into a number of difficulties. The corrosion factor alone is a serious obstacle, not to mention the variety of other service conditions. Add, too, the effects of mistakes and shortcomings in design and construction.

Management's attitude has a great effect upon maintenance costs. In some organizations, management demands that no money be spent until an actual breakdown occurs, while at the opposite extreme, some plant managers charge the maintenance organization with the responsibilty of maintaining the complete plant, buildings, and equipment in as nearly perfect condition as it is humanly possible to achieve.

However, if we make some simplifying assumptions, the boundaries of the problem can be defined so that some reasonable figures for maintenance costs can be obtained. These assumptions are:

1. Equipment has been selected with enough knowledge to insure that it can successfully withstand the service conditions while performing its intended functions.
2. Equipment will be fabricated of material possessing adequate resistance to corrosion.
3. Designer, process engineer, and construction crew did a reasonably good job of designing, sizing, and installing the equipment.
4. All necessary measures will be taken to insure good condition of the equipment at all times.

On this basis, we have attempted to determine maintenance costs for several types of well known commonly used process equipment. Wherever possible, costs are given on a chemical engineering basis, such as $ per sq ft of filtering area or $ per ton ground.

Filters

Costs given include cloth, plates, grids, drives, and any other material needed to maintain the unit as a filter.

Rotary Vacuum Filters—On an area basis, this type seems to be one of the most expensive pieces of filtration equipment to maintain. Annual costs range from $9 per sq ft of filtration surface for rubber and alloy types to $11.50 per sq ft in wooden construction.

Pressure Filters—Maintenance costs average from $1.60 per sq ft in the larger sizes to $3 per sq ft in the smaller sizes.

Intermittent Vacuum Filters—The Moore and Butters filters are still fairly widely used and seem to fall next to the rotary filters in cost, ranging from $2 per sq ft in rubber and alloy units to $4.25 per sq ft in wooden units.

Plate-and-Frame Filter Presses — These represent the lowest maintenance cost of the filter group. Costs range from $0.85 per sq ft in the rubber and alloy class to $1.10 per sq ft in wooden units.

Crushers and Grinders

Jaw and Gyratory Crushers—Used principally for preliminary size reduction, maintenance seems to be chiefly for the drive. Costs range from $70 per yr for the smaller sizes to $400 per yr in the larger sizes. On a tonnage basis on a material such as cake alum, cost will run less than $0.02 per ton of material crushed.

Pan and Roller Mills—Used for final size reduction of a wide variety of chemical raw materials and products, these mills are expensive to maintain. Grinding rings, rolls, shafts, bearings, and drive mechanism all need frequent service. Costs range from $2,000 per yr for the smaller sizes to $7,000 per yr for the larger sizes. On a tonnage basis, grinding material such as titanium dioxide, costs will range from $0.60 to $0.71 per ton handled.

Ball and Tube Mills—Mills of this type are generally used for full size reduction of very hard or abrasive materials. A classification system is usually tied in directly with the mill. Maintenance costs are chiefly for balls and tubes used to accomplish the grinding, while drive repairs and lining replacement inside the mill constitute the remainder. However, maintenance costs on certain types of classification systems are also appreciable, especially the rotating blade type used in air-cyclone systems. Maintenance costs exclusive of classifying systems average from $0.08 to $0.12 per ton ground.

Pumps

Centrifugal Pumps—These pumps, made in a variety of materials, are widely used in chemical plants. The chief cost is the maintenance of pump packing. In recent years, mechanical seals have been greatly improved and

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are tending to replace the conventional stuffing box, with greatly reduced packing costs. The costs given in Table I represent average costs by sizes. They assume the pump is built of proper material for its service. Note how increased head requirements affect maintenance costs.

Diaphragm Pumps—In certain services, this type positive-displacement pump is necessary. Its construction permits handling very thick, abrasive, or corrosive slurries and liquids, and still develop high heads. Maintenance costs, however, are correspondingly high (see Table I).

Piston Pumps—Certain services, such as the handling of heavy slurries, feeding of liquids into equipment under high pressure, and handling of viscous liquids, almost necessitate the use of piston pumps. Costs vary considerably depending on the service, but many will fall in the ranges given in Table I.

Gear Pumps—These are not as widely used as the other types of pumps, but have found usage for handling oils and other heavy, usually non-corrosive, liquids where high heads are required and the agitating action of an impeller is undesirable. Maintenance costs are fairly low, ranging from 50-60 per yr in the smaller sizes to $125-150 per yr in the 40 to 50 gpm sizes.

Tanks

Tanks are to the chemical industry what machine tools are to the metal industries. Attempting to set maintenance costs for the wide variety involved is rather difficult. However, classifying them by service does permit some average costs to be developed.

Weak Acid up to 50 deg C—Wood stave tanks are the cheapest to buy and the lowest in maintenance for this service. Maintenance usually consists of painting and tightening the hoops once or twice a year, and service lives of 10, 15, and 20 years are not uncommon. Annual maintenance costs range from $15 per 1,000 gal of capacity in the smaller sizes to $10 per 1,000 gal in the larger sizes.

Rubber-lined steel is also used for certain types of service in this range and is very satisfactory. Maintenance costs range from $40 per 1,000 gal in the larger sizes to $30 per 1,000 gal capacity in the smaller sizes. Various types of resin linings have enjoyed a fair amount of success in this class and, if properly handled, have maintenance costs ranging from $40 to $50 per 1,000 gal per yr. Stainless steel tanks are also employed for acid service where the alloy has been tested and found suitable and cheaper material cannot be used. Maintenance costs on stainless tanks are low and range from $5 to $10 per 1,000 gal per yr.

Table I—Maintenance Costs for Pumps

Gal. per Min.	Head, Ft.	Maintenance Cost, $/Yr.
Centrifugal		
30	50	$75–90
30	100	150–175
100	50	100–125
100	100	200–225
200	100	225–250
Diaphragm		
Up to 20		400–425
20–40		400–600
40–80		500–800
Piston		
Up to 20		125–150
20–40		150–175
40–80		200–250

Weak Acid From 50 deg C to Boiling—This service usually requires either lead-lined steel, or brick-lined on top of lead-lined steel. Of the two, the latter is by far the cheaper to maintain. This type ranges from $25 to $40 per 1,000 gal per yr. Lead-lined steel tanks range from $200 to $250 per 1,000 gal per yr. Haveg tanks have made a good reputation in this class and maintenance cost is low if they are properly handled. Costs range from $5 to $10 per 1,000 gal per yr.

Neutral or Alkaline Solutions — Wood stave or steel tanks are most commonly used for this service. Maintenance costs are very moderate, ranging from $10 to $15 per 1,000 gal per yr.

Special Tanks—For special services, concrete, stainless steel, aluminum, and other special materials have been used. Usually tanks in this class are fairly expensive, and materials of construction are carefully investigated in advance to insure long service and low maintenance. The cost for tanks in this class covers simple external maintenance, such as painting, cleaning, and inspection, and runs about $3 to $6 per 1,000 gal per yr.

Dryers

Continuous Belt Dryers—For large tonnages of material difficult to dry, for reason of heat sensitivity, slow diffusion, or other special considerations, the continuous belt dryer is ideal. If properly designed and installed, maintenance costs will be fairly low. Occasional fan blade replacement, steam coil replacement, and minor belt repairs are about the extent of the required maintenance. Costs as low as $300 per yr for small 8-ft wide × 30-ft long units and $400-$500 per yr for larger 8-ft wide × 70-ft long units are customary. The feed devices used with this type dryer, such as the oscillating extruder or finned drum, usually incur more maintenance expense than the dryer itself, depending on the product being handled.

Continuous Rotary Dryers—Dryers of this type are usually fairly cheap to maintain, as the chief costs result from roll, trunnion, and drive repairs and lubrication. Costs run from $100 to $300 per yr for units 6 ft dia × 30 ft long.

Furnaces and Kilns

Continuous Rotary Kilns—Where large tonnages of such materials as cement, pigments, ores, and black ash must be handled, these kilns are widely used. Maintenance costs for brick replacement at the hot end of the kiln are usually high, as the combination of high temperature, vibration, and abrasive action of the material being handled cause fairly rapid deterioration of the lining. If wet cake is fed to the kiln, the lining at the cold end is also subject to fairly rapid deterioration due to the thermal shock of the cold feed dropping onto the hot bricks.

Maintenance costs for kilns with only the usual severe hot-end condition will average $3,500 to $4,000 per yr for 9-ft dia kilns 100-150 ft long. If the kiln also has the severe cold-end condition (wet feed), maintenance costs will run $8,000-$10,000 per yr. Outside of brick repairs, minor expenditures for drive repairs, trunnion bearing lubrication, and burner tip replacement form the only other expense.

Rotary Batch Kilns—This type furnace is subjected to the severe hot-end conditions of the continuous kiln throughout its entire length. In addition, if the feed is wet or cold, the thermal shock on the lining is very severe, and linings may have to be replaced as often as once a month. Costs will average from $4,000 to $8,000 per yr for a 10-ft furnace 20 ft long.

Herreshoff Burners—Widely used in the production of sulphuric acid from pyrites, this unit is well designed for its job and is fairly reasonable to maintain. Units 18 ft in dia by 20 ft high will average as little as $3,000 per yr for maintenance.

Conveyors

Belt Conveyors—This type is used for hot and cold solids, ground and lump material, wet and dry cakes, and carries them uphill or down. Weekly lubrication of bearings and adjustment of rollers and guides form the major part of the attention required to keep these conveyors running day and night for many years. Cost of this servicing will average $100 per yr for a 100-ft section of conveyor.

Screw Conveyors—Almost as widely used as the belt conveyor, the screw conveyor is also used to move a wide variety of materials. Abrasive materials, however, take a heavy toll, causing fairly rapid wear of the conveyor flights. In addition, wet or sticky materials frequently jam at the bearings and cause broken flights, couplings, or drives. Maintenance costs will average $200 per yr for a 100-ft section of conveyor.

Moving Slat Conveyors—Frequently used in the shipping or packaging end of the plant to move finished product to the shipping or storage point, these conveyors are usually run at fairly slow speeds, and when properly installed will require little more than occasional lubrication and minor adjustment. Costs will average about $150 per yr for a 100-ft section.

Bucket-Drag Conveyors—Buckets attached to a drag chain and scraping along a concrete or metal-lined trough are employed to move red-hot ores or concentrates discharged from kilns or furnaces. Crudely devised and of heavy construction, conveyors of this type are costly to maintain, as buckets must be frequently replaced, chain and shaft breakage are common, bearings are troublesome, and drive repairs are frequent. Costs will average as much as $600 per yr for a 50-ft section.

Pan Conveyors—Cast-iron pans attached to chains are used to convey hot ores or concentrates from kilns and furnaces. In contrast to the bucket-drag conveyor, this type will give continuous service with little maintenance cost for years. A cost of $100 per yr for a 100-ft section will be representative.

Dust and Mist Collection Equipment

Electrical Precipitators—These are widely used to remove dust and acid mist from the exit gases of kilns, scrubbers, and other process equipment. Where the service requires lead-covered steel construction, you have the attendant ills of lead subjected to weak acid, temperature changes, and high-voltage electrical discharge between the electrodes. Loosening of the electrode wire, allowing it to flap against the electrode tubes and short circuit, cracking of the lead sheathing and acid attack upon the underlying steel, plus fairly frequent servicing of the electrical apparatus, all contribute to the maintenance bills. For a precipitator handling 10,000 to 15,000 cfm and containing about 90 electrodes, maintenance will run $5,000 to $8,000 per yr depending on severity of service and degree of results expected.

Bag Filters—For the removal of dust from exhaust gases, there are a number of well known and widely used bag filters of varying types. All have the common problems of bag wear and replacement and repair and servicing of whatever mechanism is used to shake or periodically discharge the dust from the bags. Maintenance averages $200 to $250 per yr per 1,000 cfm of capacity.

Cyclones—Centrifugal separators, or cyclones, are often used to separate dust or liquid droplets of coarse and intermediate sizes from a moving gas stream. Where abrasive or crystalline dusts are handled, wear of the upper high velocity section of the cyclone will be severe, and where corrosive liquid droplets are removed, this upper section is subjected to rapid wear and attack. Since these two services form the bulk of the uses for such devices, maintenance costs will run to a surprising $200 to $300 per yr per 1,000 cfm of capacity.

Screens, Sifters, and Mixers

Vibrating Dry Screens—Many processes require the separation of a ground or crystallized product into various sizes. Maintenance costs of these devices must include screen replacements due to wear and tear, plus frequent repairs to whatever means is employed to produce the vibrating motion of the screen. The electrical is superior to the mechanical type in this respect, so that costs on the electrical vibrating dry screens will average $500 to $700 per yr for 50 sq ft of screening area, as compared with $700 to $1,000 per yr for the same size screen in the mechanical type.

Vibrating Wet Screens—These units are commonly employed to remove fuzz, lint, wood chips, grit, or other impurities from slurries. Screens are of fairly small size (1 to 2 sq ft), and here again the electrical type is superior to the mechanical type so far as maintenance costs are concerned. Unfortunately, the electrical type will not always furnish the required amplitude of vibration. Costs for a 1-sq-ft electrical screen will average $150 to $300 per yr while the same size mechanical screen will run $300 to $500 per yr.

Table II—Maintenance Costs for Mixers

(Based on a 50-cu. ft. capacity machine)

Duty	Maintenance Cost, $/Yr. Continuous	Batch
Light.....	$100–200	$150–250
Medium....	200–300	300–400
Heavy.....	400–500	500–600

Mechanical Mixers and Blenders—A wide variety of mechanical mixers is used in the process industries, ranging from the heavy-duty dough mixer to the ribbon or paddle mixer. Maintenance costs are chiefly for the drives on such equipment and are dependent upon density, degree of mixing, and consistency required in the final product. Batch blenders, as a rule, require heavy repairs to the drive mechanism due to stars-stop service, but even continuous mixers and blenders involve high maintenance costs. By classing this equipment under heavy, medium, and light service, and continuous or batch duty, we can synthesize the costs shown in Table II.

Clarification Equipment

Batch Clarifiers—These units are usually nothing more than simple tanks equipped with an agitator to obtain initial mixing and an adjustable draw-off pipe to allow decanting of the clear liquid at the end of the settling period. Maintenance costs will compare very closely with those for agitated tanks.

Continuous Thickeners—Construction of the tank body is of many and varied materials, depending upon the service required, and maintenance costs will closely parallel those for tanks constructed of the same material. In addition, however, we have the maintenance of the rake arms, supports, and mechanism, which collect the settled solids and move them to the center of the tank for removal, plus the maintenance of the diaphragm pump usually employed. In non-corrosive services, a 20,000-gal unit will cost from $500 to $800 per yr for total repairs, while the same size units in corrosive services will run $2,000 to $3,000 per yr.

Table III—Maintenance Costs for Process Piping
($/yr, based on 100 ft of pipe containing 6 fittings and 2 valves)

Nominal size	1 in.	1½ in	2 in.	3 in.	4 in.	6 in.
Steel	$10	$15	$20	$25	$30	$50
Cast iron	6	8	12	16	20	25
Brass	8	12	16	20	25	35
Stainless steel	7	10	14	18	22	28
Rubber-lined steel	—	20	30	40	55	70
Glass	22	30	40	50	60	80
Porcelain	25	35	45	55	75	100
Carbon	30	45	60	80	—	—
Silver	50	75	90	—	—	—
Rubber hose	6	10	18	22	28	36

Table IV—Maintenance Costs for Service Piping
($/yr, based on 100 ft of pipe containing 4 fittings and 1 valve)

Nominal size	1 in.	1½ in.	2 in.	3 in.	4 in.	6 in.	8 in.	12 in.
Steel (uninsulated)	$4	$8	$11	$15	$19	$26	$40	$60
Steel (insulated)	7	15	20	28	35	45	75	110
Brass	6	9	14	20	27	—	—	—
Cast iron	5	10	16	24	31	42	—	—

Piping

Process Piping—One of the most important items of maintenance on the modern chemical process plant is the process piping. What a complex array has been used—glass, porcelain, steel, cast iron, stainless steel, plastics of many types, rubber-lined steel, wooden (yes, even wood), rubber hose, concrete, tile, brick-lined steel, many kinds of metal alloys, aluminum, brass, carbon, platinum, lead, silver, and gold. Careful analysis of maintenance costs for process pipelines has yielded the data presented in Table III, based on a 100-ft run containing 6 fittings and 2 valves.

Service Piping—A similar tabulation for service piping used to distribute steam, water, gases, vacuum, etc., around the plant is given in Table IV.

Instruments

In recent years, the development of automatically controlled processes has been one of the chief advances of the chemical process industries and, likewise, one of the most poorly handled as far as maintenance is concerned. The author has seen examples of beautifully designed and instrumented units run by two or three operators per shift, in which banks of instruments and remote controls replaced the labor of three other men each shift, or a saving of nine men per day in operating labor. However, it took the full time attention of five instrument mechanics each day to keep the unit going, or a net saving of only four men per day! This lesson has been costly in some cases, and chemical engineers are learning to approach the instrumentation of processes with greater care.

Rather than try to assign individual costs to instruments, an over-all average shows that a figure of 20-25 percent of the original cost of the instrument will suffice for servicing and maintenance.

Conclusion

Smartly designed plants of the future will consider the maintenance angle as fully as the operating aspects —or else suffer the penalty in the form of high maintenance costs. A review of the preliminary plant design by a maintenance expert can save many dollars in the course of the operating life of that plant. This review should cover not only the arrangement, layout, and accessibility of the equipment, but also the type, design, and fabrication of the equipment itself.

Flotation Costs

(*Continued from p 231*)

Operating Costs

Operating costs were collected from 22 sulphide flotation plants treating 211,621 tpd of Cu, Pb, Zn, Pb-Zn, Cu-Pb-Zn, Cu-Mo and Cu-Ag ores in the U.S., Canada and Latin America. These costs covered either the year 1959 or the first six months of 1960. Summary is shown in Table 2.

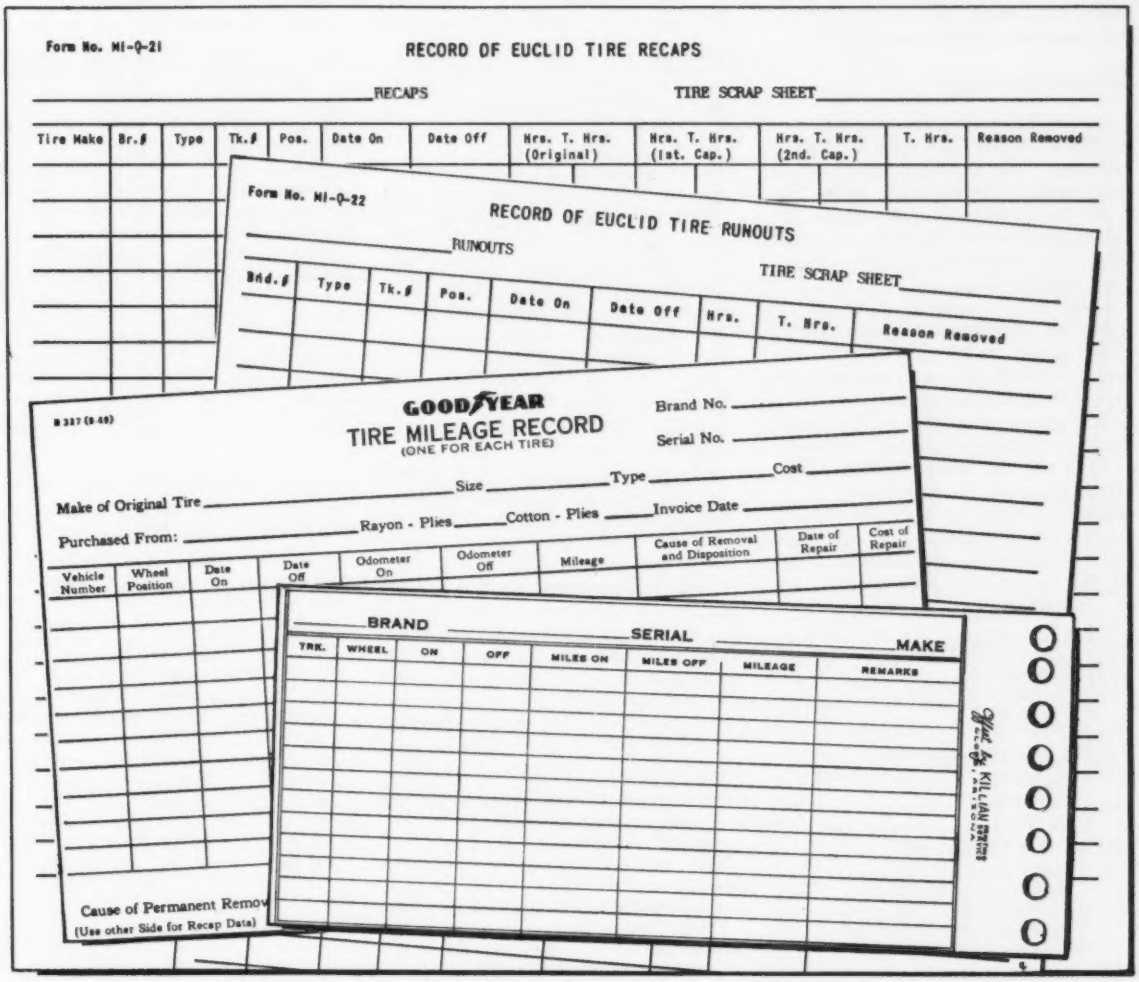
Certain of these milling costs can be broken down another way as follows:

Maintenance	$0.093—$0.14/ton (5 mills, 40,000 tpd feed)	
Power	0.18—0.47/ton	12 mills, 53,320 tpd feed
Labor	0.049—0.69/ton	
Supplies	0.017—1.27/ton	

Table 2—Operating Costs (1959-1960) per Ton of Ore Treated at 22 Sulphide Flotation Plants Treating 211, 621 tpd of Cu, Pb, Zn, Pb-Zn, Cu-Pb, Zn, Cu-Mo and Cu-Ag Ores at Rates from 800 to 46,000 tpd

Item	High	Low	Weighted Average[a]	%	Arithmetic Average[b]	%
Unloading, crushing	$0.391	$0.050	$0.067	10.7	$0.101	8.4
Grinding	0.650	0.100	0.220	35.3	0.272	22.6
Flotation[c]	0.860	0.062	0.108	17.3	0.276	22.9
(Reagents)	(0.50)	(0.017)	(0.052)	(8.3)	(0.149)	(12.4)
Filtration, drying, loading	0.260	0	0.018	2.9	0.051	4.2
Tailings disposal	0.060	0.002	0.016	2.6	0.026	2.2
Misc.	0.680	0	0.036	5.8	0.136	11.3
Total Direct	2.20	0.319	$0.465	74.6	$0.862	71.6
Indirect	1.66	0.056	0.159	25.4	0.342	28.4
Grand Total	3.86	0.375	$0.624	100.0	$1.204	100.0

[a] Based on total daily tonnage.
[b] Based on number of mills.
[c] Including reagent cost. Reagents costs are shown in parentheses.



THESE FORMS REPRESENT the wide-spread interest among open-pit operators to keep better track of their tires. Good record-keeping, which means noting tire mileage, repairs and replacements, can be management's best bet for tire economy.

Money-Saver: Keeps Tabs on Your Tires

HAULAGE COSTS, as even the newest open-pit operator knows, rank with the biggest items in a mine operation budget. And keeping trucks supplied with good tires accounts for at least one dollar in every three spent on moving ore (See E&MJ, June 1960, p. 244). To get top use of this expensive essential, the mine operator must have current and past performance data at his fingertips, and this in turn means that systemized record-keeping should be in effect from the moment a new tire enters the supply shop till the day it's moved off to the scrap heap. The big problem that records can help solve: whether to run a tire to destruction or to repair it. Good records, and some sensible interpretation, can justify the mine operator's repair expenses.

Taking Tire Data

Record-keeping systems vary with the needs of individual operators, but the way one large mine does it points up four important factors probably basic to everyone:

1. Tire number—Tires are branded —like cattle—with a company number to make identification accurate and easy. All other records are keyed to this brand number.

2. Hours-of-service — Each driver turns in a report at the end of his shift, noting the number of trucks that he's operated that day and the hours on each. From this record, a company clerk can tally the time on each tire on the hours-of-service master sheet.

3. Tire-change tag—When a driver brings a truck in for a tire change, the repair crew fills out a tag to show the switch in tire brand numbers, the wheel position where the change was made, tire damage, disposition of the damaged tire and time and materials.

4. Hours-of-operation—At the end of the 8-hour shift, all personnel turn in tags so that information can be transferred to the hours-of-operation card on file for each tire. Thus, ac-

cording to this mine's officials, individual tire service and cost history are "as fresh as yesterday's reports."

What's Its Age?

Record-keeping takes on real importance when open-pit operators compare their detailed results of a tire's actual performance with "life expectancy" schedules developed by rubber manufacturers, such as Goodyear and Firestone, to gage off-the-road performance.

Goodyear, in setting up its list of operating conditions (shown below), chose 50,000 miles as about the top performance figure an operator could expect from an off-the-road tire. Safety engineers next graded each possible driving situation or "factor," as a percentage of the ideal situation. The mathematics of "life expectancy" then becomes simple: to find how many miles a tire is worth, the operator can take 50,000 miles and multiply it by all the factors that best describe his own conditions.

No.	Conditions	Factor
I	**Maintenance**	
	Excellent	1.0
	Average	0.9
	Poor	0.7
II	**Speeds (maximum)**	
	10 MPH	1.0
	20 MPH	0.8
	30 MPH	0.6
III	**Surface Conditions**	
	Soft Earth—No Rock	1.0
	Soft Earth—Some Rock	0.9
	Well maintained gravel road	0.9
	Poorly maintained gravel road	0.7
	Blasted sharp rock	0.6
IV	**Wheel Positions**	
	Trailing	1.0
	Front	0.9
	Driver (Rear Dump)	0.8
	(Bottom Dump)	0.7
	(Self Propelled Scrapers)	0.6
V	**Loads** (See No. VIII note)	
	Tire & Rim Assoc. Recommended	1.0
	20% overload	0.8
	40% overload	0.5
VI	**Curves**	
	None	1.0
	Medium	0.9
	Severe	0.8
VII	**Grades (Drive Tires Only)**	
	Level	1.0
	6% Maximum	0.9
	15% maximum	0.7
VIII	***Other Miscellaneous Combinations**	
	None	1.0
	Medium	0.9
	Severe	0.8

*Used only when overloading is present with one or more of the first four conditions or when other small, but detrimental, conditions influence tire life.

Fig. 1 Record of Tires Deliberately Run to Destruction

(All 18x25 except for A which is 18x24.)

Make	On	Off	Section	New	Total	Hours	Miles
A	11/22/56	4/29/57		$ 673.06	$ 673.06	2,163	8,938
B	12/27/56	3/12/57		685.69	685.69	978	4,362
C	12/10/56	8/29/57		629.36	629.36	2,885	17,444
D	12/11/56	4/12/57		629.36	629.36	1,497	7,972
E	12/3/56	5/16/57		695.58	695.58	2,167	11,519
F	11/1/56	6/25/57		685.69	685.69	2,862	13,019
G	12/5/56	5/21/57		685.69	685.69	2,249	14,307
H	12/31/56	8/30/57	$183.76	689.65	873.41	1,564	9,823
I	12/31/56	12/17/57	86.21	689.65	775.86	3,906	22,053
J	12/31/56	6/18/57	86.21	685.69	771.90	1,167	3,520
K	12/11/56	3/25/57		629.36	629.36	1,435	10,202
L	12/7/56	6/12/57		685.69	685.69	2,617	19,512
M	1/29/57	12/2/57		695.58	695.58	2,828	17,481
N	1/29/57	5/10/57		695.58	695.58	1,410	10,644
O	12/13/56	7/18/57		685.69	685.69	2,497	15,226
P	12/11/56	8/29/57		629.36	629.36	2,998	17,811
Totals				$10,770.68	$11,126.86	35,223	203,836
Average						2,200	12,750

Average Cost for all 18 × 24 — 25 Tires Run to Destruction in 1957
Average Cost/Hr. this test = $.316 Average Cost/Hr. = $.337
Average Cost/Mi. this test = $.055 Average Cost/Mi. = $.060

Fig. 2 Summary of Scrapped Euclid Tires, December 1957

	14 x 24	18 x 24	18 x 25	Total
No. of tires scrapped this month			6	
Year to date	41	12	55	108
Cost of tires scrapped this month			$ 4,161.83	$ 4,161.83
Year to date	$18,059.41	$ 9,683.57	$43,070.27	$70,813.25
Ave. cost per mile as a recap this month			$0.0273	
Year to date	$0.0209	$0.0268	$0.0261	
Break even cost per mile as recap.	$0.0188	$0.0261	$0.0261	
Ave. cost per mile of scrapped tires this month			$0.047	
Year to date	$0.033	$0.062	$0.055	$0.0477
No. tire changes due to tube failure this month	1			1
Year to date	30	6	19	55
Scrapped new or recaps with less than 5000 mi. this month				
Year to date	4	2	6	12
No. of tires recapped this month	6		12	18
Year to date	41	3	23	67
Ave. new cost tires scrapped this month			$682.00	
Year to date	$330.00	$678.00	$672.00	
Ave. cost recapping tires scrapped this month			$246.17	
Year to date	$145.00	$255.00	$269.00	

For example, he may determine mileage expectancy of a tire set on the wheel of a rear dump truck (factor IV), which carries ore from the open pit. Vehicle maintenance is rated average (I), and the driver keeps the load normal (V) and speed below 20 mph (II). Company engineers say the road has a maximum grade of 15% (VII) with medium curves (VI) and a good gravel surface (III). Total mileage, according to the operator's calculations, equals 50,000x0.8x0.9x0.8x0.7x0.9x 0.9 which comes to 16,300 miles.

But, of course, this example is strictly hypothetical. And it ignores the one controversy that no "life expectancy" chart can answer: running-to-destruction versus recapping. Suppose the rear dump truck tire shows serious cuts and breaks, enough to bite deeply into its expected life of 16,300 miles. Will the new expense, added to the original purchase price, of a major repair job give the tire enough of a second wind to make recapping worthwhile? The mine operator may not know, but with a good, up-to-date set of records and with the knowledge of someone else's experience, he may be able to find out.

(*Continued on next page*)

MacIntyre's Methods

One source accessible to him: a thorough study of tire performance at National Lead Co.'s ilmenite operation, the MacIntyre development, at Tahawus, N.Y. After analysis of the 1957 results, company management showed that for that period, at least, recaps did not perform better than tires that are run to destruction. Differences in operating conditions rule out generalizations on this score, but the outcome at MacIntyre is worth examining.

MacIntyre figures tire performance on the basis of miles run and, as a partial check, records total engine hours also. The record (Fig. 1) of a series of MacIntyre run-outs (jargon for tires run to destruction) shows the wide variation, however, in miles per engine hour, and company management has concluded that the mileage method gives better data.

MacIntyre uses the information from their Scrapped Tire summaries (Fig. 2) to calculate whether to run to destruction or to recap; and from the same data they can estimate what their goals will be. A sample calculation shows how mine officials decide if they are winning or losing by recapping. Source of data: 18x24 and 18x25 tires which, for practical purposes, perform equally.

Average purchase cost of run-outs. $665
Average cost of recaps..... $259
Average mileage to recap.....11,100
Average mileage of best performing 50% of run-outs.....15,000

The cost of run-out is:

$$\frac{\$665}{15,100} = \$.044/\text{mile}$$

and break-even life of the recap must be:

$$\frac{\$665 + 259}{\$.044} = 21,000 \text{ miles}$$

Break-even recap performance is then:

$$21,000 - 11,100 = 9,900 \text{ miles}$$

But the average performance of recaps on these tires in 1957 was only 9,800 miles. The loss for the year, then, would be:

$(9,900 - 9,800) \times \$0.044 \times 25 \text{ tires} = \$110.$

MacIntyre uses the same sort of method as a guide in reducing costs, and probably cut and broken tires is the one most vulnerable to attack. A reasonable goal, for example, might be to raise the average of the 1957 run-outs to the average of the best performing run-outs of that year. The approach would then be:

Run-out cost –

$$\left(\text{Run-out cost} \times \frac{\text{Av run-out mileage}}{\text{Av Best 50\% mileage}}\right),$$

or

$$\$29,251 - \$29,251 \times \frac{11,050}{15,100} = \$7,850;$$

and improving recap performance to the same degree,

$$\$\ 6,460 - \$\ 6,460 \times \frac{10,250}{12,150} = \$1,010$$

or $8,860 for total saving.

This saving, possible with a reasonable reduction in cuts and breaks, is 25% of the 1957 cost of 18x24-25 tires and could be a direct reduction in costs. Indirect savings in shop labor would result, of course, but more important is the possibility that average tire performance could be improved to the point where recapping would be profitable.

Another line of attack: sectioning damaged tires. MacIntyre statistics show some economic advantages when tires—scheduled to be run-outs—are sectioned. For example, 18 sections on 18x24-25 tires ran 68,209 miles and cost $1,562 for a per-mile charge of $0.0229. This compares favorably with the $0.044 per mile of 50% of the best performing run-outs in 1957.

MacIntyre has also evolved minimum mileage for recap performance, based on the assumption that 18x24-25 tires do not cut or puncture and could be expected to run 15,000 miles before recapping or 20,000 miles to destruction. With still no cuts or punctures after this first recap, the tire could be expected to run 12,000 miles to the second recap or another 15,000 miles to destruction. Here's an actual example of MacIntyre calculations:

$$\text{Run-out cost} = \frac{\$687}{20,000} = \$0.0344/\text{mile}$$

Break-even life would then be:

Original + recap cost/$0.0344, or

$$\frac{\$687 + 262}{\$0.0344} = \$27,600 \text{ miles for the first recap.}$$

To break even, the first recap must run 27,600—15,000, or 12,600 miles to the second recap.

$$\text{Run-out cost, first recap} = \frac{\$687 + 262}{15,000 + 15,000} = \$0.0316/\text{mile}$$

Then break-even life for the second recap would be:

$$\frac{\$687 + 262 + 262}{\$0.0316} = 38,300 \text{ miles.}$$

And to break even, the second recap must run 38,300—30,000, or 8,300 miles. Second recap run-out cost is then:

$$\frac{\$687 + 262 + 262}{15,000 + 12,000 + 13,500} = \$0.30/\text{mile.}$$

Indicated savings if the first recap is run to destruction is:

$$(\$0.0344 - 0.0316)\ 30,000 = \frac{\$84}{\$949} \times 100 = 8.85\% \text{ on cost.}$$

And on second recap, the savings would be:

$$(\$0.0344 - 0.030)\ 40,500 = \$178 - \frac{\$178}{\$1,211} \times 100 = 14.7\% \text{ on cost.}$$

These figures show that under given conditions, there would be no dramatic savings, and it would not take many damaged tires to wipe out any expected gain from recapping.

Result: since 1957, the last year at Tahawus that conditions were consistent enough to judge tire performance accurately, recapping has been abandoned. National Lead's MacIntyre Development, looking for better tire wear, introduced "extra-tread" tires late in 1959, has gotten satisfactory performance to date, and now feels that recapping stands a better chance of being profitable.

Other statistical approaches are taken by various operators. For instance, the industrial engineers of one large western concern make a thorough probability study, basing their work on a comprehensive set of curves which show performance of "samples," batches of tires identical in size, make, duty and time started in service. Their scheme, as does MacIntyre's, helps set up operating procedures, emphasizes trends which bring tire trouble and expense.

How Two Do It

And keeping a careful check on performance often leads, as in the case of Inspiration Consolidated Copper at Inspiration, Ariz., to extensive recapping, increase in tire life and decrease in tire cost per mile. Coincidental with the hiring of a tire foreman, the price of ICC's truck maintenance started on a steep decline. As part of the routine, each driver gives his tires a daily inspection, followed up by a weekly once-over by the tire foreman who pays particular attention to the front tires, which receive the most wear. After every third shift, while each truck gets checked out, tires are thoroughly examined and air pressure is measured. All information goes on individual record cards, and the tire foreman files a monthly report, noting number and type of tires in use, average mileage and average cost per mile.

Kennecott Copper's Ray Mines, at Ray, Ariz., runs a similar set-up. Like ICC, Ray's tires get a visual and air pressure check by maintenance personnel, followed by the foreman's beweekly inspection, made just before the truck goes on production. Again, there is a constant watch for recap carcasses, but foremen may decide to

run a tire to destruction. Each tire has a card record, and the tire maintenance section is responsible for a monthly report.

But even with Kennecott's and ICC's efficient record-keeping systems and the good tire maintenance that results, costs are still high: open-pit operations extort a high price in damage repairs. The MacIntyre Development has already pointed out that the cutting and breaking rate of the 18x25 extra-tread rear tires — first put on Tahawus trucks 18 months ago—has been "disappointingly high." Cost per mile rates have gone down, but records show that a hefty 12,000 miles has been chopped from the 18x25's expected 35,000 mile lifetime performance.

Searching for Savings

Four new research developments are now commercial enough, however, to cut tire cost and increase tire life. U.S. Rubber offers two, starting with steel reinforced tread (SRT) for large OTR tires, which, says company management, gives better carcass protection and extends tire service. SRT composition: a thick layer of tread rubber with hundreds of thousands of fine, brass-plated steel filaments, all interlaced to form a protective mat between the tread and cord body of the tire. Steel reinforcement adds resistance to cutting and penetration, and during the testing period, SRT proved to be up to twice as tough on the road as its competition. Reasons for superiority, according to data released by commercial users: better than usual recappability; lower ply separation; reduction in operating temperature; fewer repairs; and less handling.

U.S. Rubber also expects that its off-the-road tubeless, with the new "Built-In" O-Rings, should cut air seepage losses that make it hard with present models to build up enough pressure to set the bead properly against the rim. The innovation: "Built-In" O-Rings consist of two semi-circular rubber ridges, which run around the bead base, flowing into rim inequalities to supply a positive air seal.

With an eye on stopping tread cracking, cuts and ply separation, DuPont has introduced post-inflation: pilot plant engineers inflate a nylon cord tire, fresh from the mold, then cure it under pressure at close to the dimensions the tire would achieve in service. This prevents tread groove contraction as the cord cools. Results show that the tire isn't forced to "grow" back to service dimensions and thus undergo strains that start cracks and ply separations. Using the new technique to take advantage of nylon's natural strength, fabricators can now reduce the number of plies going into a tire. Ten ply is already in use, and experts claim that even 4-ply tires are possible.

Finally, American Latex Products has come out with a tire packed with foamed urethane filling, which keeps tire shape even after severe cuts and punctures.

Reason: the filling forms a permanent bond with the casing and metal rim. With the material, tradenamed Polyrubber, tires achieve greater stability, less lateral distortion and better shock absorption.

Even with all this, including good record-keeping, adequate maintenance and the best products on the market, pit operators must follow proper storage rules to make their tire savings count. One producer recommends these for tire care:

Tubes

1. Tires in storage or transit must be protected from rain or snow to prevent water accumulating in the casing. It is recommended that all tires be checked before mounting if there is a possibility of water, as this condition is very damaging to the casing and will cause premature failure. Make certain casings are dry before mounting.

2. Storage rooms should be dark, cool, dry, clean and free from drafts. Sunlight and heat cause rubber to "age" and lose strength and elasticity. Moving air oxidizes faster than still air. Ozone produced by electrical discharges also increases oxidation. Do not store near electric motors, generators, welding equipment, etc.

Avoid exposing tires to contact with oil, grease, gasoline, etc. If necessary, cover floors with clean wooden slats at least one-half inch thick.

3. Keep tire storage room as cool as possible. Low temperatures are desirable. Do not store near boilers, radiators, or other sources of heat.

4. Large tires can be placed vertically in stalls, with V-shaped support under them to spread the load. Shift tire position periodically to prevent flat-spotting.

5. Tires not too large and heavy to be piled, should be stacked horizontally and not laced or staggered. Limit the height of each pile so that the bottom tire is not distorted.

Do not put tires of different sizes in the same pile, unless storage space is limited. In that case, put the larger tires at the bottom.

6. Before storing used tires, clean them thoroughly, inspect carefully for any damages and repair if necessary.
7. If tires must be stored out of doors —whether unmounted or mounted on vehicles—clean and dry them, finally, wrap or cover them with waterproof material.
8. When a rubber-tired vehicle is placed in storage, block it up to take its weight off the tires, and reduce air pressure. If the vehicle cannot be blocked up, check air pressures twice a month and keep tires properly inflated. A waterproof covering prolongs the life of both vehicle and tires.

Tubeless

The same precautions which apply to conventional tires should be followed for tubeless tires. In addition:

Tubeless tires should be stored vertically. Horizontal stacking may compress the tires and make inflation difficult. If tires are stored in racks, the lower supporting members should present as broad a surface as possible to the tire tread to avoid concentration of load.

Tire beads must be protected from damage or faulty air seal will result. Do not use hooks, cables or chains in contact with beads for lifting. Fork lift truck arms should be broad and well-rounded to distribute load, and rounded at the end to avoid damage to tires. When loading or unloading, do not move truck arms in or out of beads when carrying load as the "drag" on tire beads may damage the rubber covering.

Special care should be taken to prevent damage to the tire innerliner. Do not permit contact with tools or foreign materials. The innerliner should be protected against sun and rain and other elements that may cause deterioration.

Air lines for inflation should be well trapped to eliminate moisture which would cause rims to corrode, and oil, which deteriorates the tire inner liner.

In the end, however, the right approach to record-keeping and cost analysis begins with an open-pit operator's honest self examination of his haulage operation: whether he can pinpoint his own weaknesses. If they can be found and he sees a solution, holding periodic meetings with the employees, complete with movies and discussion sessions about tire damage, can work wonders in creating job-wide interest in the problem. Tire care can then originate with the truck driver and the shop repairman. Most mining fleets are small enough to have a close 3-way liaison between drivers, maintenance men and the supervisors.

E&MJ's
1961 BUYING DIRECTORY

This year, the product classification and manufacturer's index are incorporated into one section—every time a company is listed, it appears with its complete mailing address. Companies that are advertising in this issue appear in **bold face type** with the advertisement page number.

The list of advertiser's district sales offices starts on page 281 and the classified section (Searchlight) is on page 369.

ABRASIVES *Also See* **CARBIDE; DIAMONDS**

Aluminum Co of America — 1501 Alcoa Bldg, Pittsburgh 19 — Pa
American Optical Co, Safety Products Div — 98 Mechanic St, Southbridge — Mass
Black & Decker Mfg Co — 600 E Pennsylvania Ave, Towson — Md
DIAMOND TOOL RESEARCH CO. INC., Adv Pg 363 — **380 Second Ave. New York 10** — **NY**
Exolon Co — E Niagara St, Tonawanda — NY
Ideal Industries, Inc — 1020 Park Ave, Sycamore — Ill
Macklin Co — 2917 Wildwood Rd, Jackson — Mich
Minnesota Mining & Mfg Co — 900 Bush Ave, St Paul 6 — Minn
Norton Co — 1 New Bond St, Worcester 6 — Mass
Porter-Cable Machine Co — 700 Marcellus St, Syracuse 4 — NY
U S Rubber Co, Mechanical Goods Div — 1230 Ave of the Americas, New York 20 — NY
Wheelabrator Corp — 1474 S Byrkit St, Mishawaka — Ind

ACETYLENE GENERATORS *See* **GAS GENERATORS**

AERATORS

Bin-Dicator Co — 13946-300 Kercheval Ave, Detroit 15 — Mich
Chase Brass & Copper Co — 236 Grand St, Waterbury 20 — Conn
EIMCO CORP., Adv Pg 335 — **501 W 6th South St. Salt Lake City 10** — **Utah**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 — **135 S LaSalle St. Chicago 3** — **Ill**
Infilco, Inc — 901 S Campbell Ave, Tucson — Ariz
Link-Belt Co, Dept. EMJ-61 — Prudential Plaza, Chicago 1 — Ill

AERIAL CABLE TRAMWAYS *Also See* **EXCAVATORS—DRAGLINE TOWER**

American Chain & Cable Co, American Cable Div — Wilkes-Barre — Pa
FUEL & IRON CORP., Adv Pg 38 — **640 S Broad St. Trenton 2** — **NJ**
General Cable Corp — 730 Third Ave, New York 17 — NY
INTERSTATE EQUIPMENT CORP., Adv Pg 361 — **433 N Broad St. Elizabeth 3** — **NJ**
Lidgerwood Mfg Co — 7 Day St, New York — NY
RIBLET TRAMWAY CO., Adv Pg 323 — **P O Box 5239, Spokane 17** — **Wash**
ROEBLING'S, JOHN A., SONS, DIV. COLORADO — Superior-Lidgerwood-Mundy Corp — 1101 John Ave, Superior — Wis
Washington Iron Works — 1500 6 Ave. S, Seattle 4 — Wash

AERIAL TOWERS *See* **BOOMS & TOWERS—EXTENSIBLE**

AGGLOMERATING *See* **NODULIZING; SINTERING; WATER CLARIFICATION**

AGITATORS & MIXERS—GAS

BETHLEHEM STEEL CO., Adv Pg 46 — **Bethlehem** — **Pa**
Christian, J. D., Engineers — 480 Potrero Ave, San Francisco 10 — Cal
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 — **82 Beaver St. New York** — **NY**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 — **135 S LaSalle St. Chicago 3** — **Ill**
Ironton Engine Co — Paynters Rd, Farmingdale — NJ
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
MIXING EQUIPMENT CO., Adv Pg 135 — **234 Mt Read Blvd, Rochester 3** — **NY**
PHILADELPHIA GEAR CORP., Adv Pg 294 — **King of Prussia** — **Pa**
TREADWELL, H.N., CO. INC., Adv Pg 75 — **140 Cedar St. New York 6** — **NY**

AGITATORS & MIXERS—LIQUIDS & SLURRIES *Also See* **FLOTATION MACHINES; SCRUBBERS**

Abbe Engineering Co — 622C Graybar Bldg, New York 17 — NY
ATLAS POWDER CO., Adv. Pgs. 178-179 — **Wilmington 99** — **Del**
BETHLEHEM STEEL CO., Adv Pg 46 — **Bethlehem** — **Pa**
Booth Co, Inc — 333 W 14 S, Salt Lake City 15 — Utah
Christian, J. D., Engineers — 480 Potrero Ave, San Francisco 10 — Cal
Crossley Machine Co — Mammoth & Bell Sts, Trenton — NJ
DENVER EQUIPMENT CO., Adv Pg 76 — **Box 5268, Denver 17** — **Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 — **82 Beaver St. New York** — **NY**
DORR OLIVER INC., Adv. Pgs. 8-9 — **Stamford** — **Conn**
EIMCO CORP., Adv Pg 335 — **501 W 6th South St. Salt Lake City 10** — **Utah**
Fluor Products Co — Box 1767, Santa Rosa — Cal
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 — **135 S LaSalle St. Chicago 3** — **Ill**
HARDINGE CO. INC., Adv. Pgs. 340-341 — **240 Arch St. York** — **Pa**
Haynes Stellite Co, Div. Union Carbide Corp — Kokomo — Ind
Infilco, Inc — 901 S Campbell Ave, Tucson — Ariz
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
McLANAHAN CORP., Adv Pg 320 — **Hollidaysburg** — **Pa**
MIXING EQUIPMENT CO., Adv Pg 135 — **234 Mt Read Blvd, Rochester 3** — **NY**
PHILADELPHIA GEAR CORP., Adv Pg 294 — **King of Prussia** — **Pa**
TREADWELL, H.N., CO. INC., Adv Pg 75 — **140 Cedar St. New York 6** — **NY**
Western Machinery Co, Wemco Div — 650 Fifth St, San Francisco 7 — Cal

AIRCRAFT

Beech Aircraft Corp — Wichita 1 — Kan

AIR COMPRESSORS—MOVABLE & PORTABLE

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St. Milwaukee 1** — **Wis**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Beach-Russ Co — 420 Lexington Ave, New York — NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
CLARK BROTHERS CO. ONE OF THE DRESSER INDUSTRIES, Adv Pg 31 — **Olean** — **NY**
Essick Mfg Co — 1950 Santa Fe Ave, Los Angeles 21 — Cal
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Jaeger Machine Co — 550 W Spring St, Columbus 16 — Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg, Pittsburgh 22** — **Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 388-389 — **Sidney** — **Ohio**
Lincoln Engineering Co, Div. McNeil Machine & Engineering Co — 4010 Goodfellow Blvd, St Louis 20 — Mo
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
Schramm Inc — 870 E Virginia Ave, West Chester — Pa
Sutabilt Corp, Fuller Co — 2966 E Victoria St, Compton — Cal
Thor Power Tool Co — 175 N State St, Aurora — Ill

AIR COMPRESSORS—ROTARY

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St. Milwaukee 1** — **Wis**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Beach-Russ Co — 420 Lexington Ave, New York — NY
Brown Boveri Corp — 19 Rector St, New York 6 — NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
CLARK BROTHERS CO. ONE OF THE DRESSER INDUSTRIES, Adv Pg 31 — **Olean** — **NY**
Fairbanks, Morse & Co — 600 S Michigan Ave, Chicago 5 — Ill
Fuller Co, Sub of General American Transportation Corp — Catasauqua — Pa
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Jaeger Machine Co — 550 W Spring St, Columbus 16 — Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg, Pittsburgh 22** — **Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 388-389 — **Sidney** — **Ohio**
Lincoln Engineering Co, Div. McNeil Machine & Engineering Co — 4010 Goodfellow Blvd, St Louis 20 — Mo
Long-Airdox Co, Marmon-Herrington Inc — P O Box 331, Oak Hill — W Va
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
Nash Engineering Co — 218 Wilson Rd, South Norwalk — Conn
Pennsylvania Pump & Compressor Co — Easton — Pa
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327 — **900 W Mount St. Connersville** — **Ind**
Schramm Inc — 870 E Virginia Ave, West Chester — Pa
Sutabilt Corp, Fuller Co — 2966 E Victoria St, Compton — Cal
TREADWELL, H.N., CO. INC., Adv Pg 75 — **140 Cedar St. New York 6** — **NY**
Westinghouse Air Brake Co, Ind Products Div — P O Box 36, Wilmerding — Pa

AIR COMPRESSORS—STATIONARY

Alemite Div, Stewart-Warner Corp — 1826 Diversey Pkwy, Chicago 14 — Ill
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St. Milwaukee 1** — **Wis**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Beach-Russ Co — 420 Lexington Ave, New York — NY
Brown Boveri Corp — 19 Rector St, New York 6 — NY
Carrier Corp — Carrier Pkwy, Syracuse 1 — NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
CLARK BROTHERS CO. ONE OF THE DRESSER INDUSTRIES, Adv Pg 31 — **Olean** — **NY**
Essick Mfg Co — 1950 Santa Fe Ave, Los Angeles 21 — Cal
Fairbanks, Morse & Co — 600 S Michigan Ave, Chicago 5 — Ill
Fuller Co, Sub of General American Transportation Corp — Catasauqua — Pa
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Jaeger Machine Co — 550 W Spring St, Columbus 16 — Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg, Pittsburgh 22** — **Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 388-389 — **Sidney** — **Ohio**
Lincoln Engineering Co, Div. McNeil Machine & Engineering Co — 4010 Goodfellow Blvd, St Louis 20 — Mo
Long-Airdox Co, Marmon-Herrington Inc — P O Box 331, Oak Hill — W Va
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
Nash Engineering Co — 218 Wilson Rd, South Norwalk — Conn
Pennsylvania Pump & Compressor Co — Easton — Pa
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327 — **900 W Mount St. Connersville** — **Ind**
Schramm Inc — 870 E Virginia Ave, West Chester — Pa
Sutabilt Corp, Fuller Co — 2966 E Victoria St, Compton — Cal
TREADWELL, H.N., CO. INC., Adv Pg 75 — **140 Cedar St. New York 6** — **NY**
Westinghouse Air Brake Co, Ind Products Div — P O Box 36, Wilmerding — Pa

AIR COMPRESSOR AFTER-COOLERS

American Standard Industrial Div	Detroit 32	Mich
ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
Blown Bovers Corp	19 Rector St. New York 6	NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Johnson Corp	882 Wood St. Three Rivers	Mich
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301	**Sidney**	**Ohio**
Pennsylvania Pump & Compressor Co	Easton	Pa
Schramm Inc	870 E Virginia Ave. West Chester	Pa
Westinghouse Air Brake Co. Ind Products Div	P O Box 36, Wilmerding	Pa

AIR LINE OILERS

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Cleveland Vibrator Co	2828 Clinton Ave. Cleveland 13	Ohio
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Lincoln Engineering Co. Div. McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Parker-Hannifin Corp	1735 Euclid Ave. Cleveland 12	Ohio
Schramm Inc	870 E Virginia Ave. West Chester	Pa
Victor Equipment Co. Alloy Rod & Metal Div	13808 E Imperial Hwy. Norwalk	Cal
Westinghouse Air Brake Co. Ind Products Div	P O Box 36, Wilmerding	Pa
Wilkerson Corp	1604 W Mansfield Ave. Englewood	Colo

AIR MOTORS

ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
Beach-Russ Co	420 Lexington Ave. New York	NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Minneapolis-Honeywell Regulator, Brown Instrument Div	Wayne & Windrim Ave. Philadelphia 44	Pa
Parker-Hannifin Corp	17325 Euclid Ave. Cleveland 12	Ohio

AIR PREHEATERS *See* HEATERS

AIR RECEIVERS *Also See* TANKS

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301	**Sidney**	**Ohio**
Simmons Boiler & Machine Co	9011 Central Ave. Detroit 4	Mich
TREADWELL, H.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
The Weatherhead Co	300 E 131st St. Cleveland 8	Ohio
Westinghouse Air Brake Co. Ind Products Div	P O Box 36, Wilmerding	Pa

AIR VALVES *See* VALVES

ANALGAMATING PROCESS EQUIPMENT *(SPECIAL) DOES NOT INCLUDE STANDARD AUXILIARY EQUIPMENT*

DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Englehard Industries, Inc	113 Astor St. Newark	NJ

AMMETERS & VOLTMETERS *See* METERS—*ELECTRICITY*

ANEMOMETERS *See* METERS—*FLUID*

ARCH PLATES *See* MINE SUPPORTS

ARRESTERS—*LIGHTING*

DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**62 Beaver St. New York**	**NY**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
General Railway Signal Co	Rochester 2	NY
Line Material Industries, McGraw-Edison Co	700 W Michigan St. Milwaukee 1	Wis
Ohio Brass Co	Mansfield	Ohio
H. K. Porter Co., Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
Union Switch & Signal Div. Westinghouse Air Brake Co	Swissvale	Pa
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

ASSAYING *See* LABORATORY

AUTOCLAVES *See* TANKS

BAG FILLING MACHINES

Stemis Bros. Bag Co	408 Pine St. St Louis 2	Mo
Richardson Scale Co	Clifton	NJ
Thayer Scale	Pembroke	Mass

BAGS—*PAPER—FABRIC & PLASTIC Also See* BLASTING BAGS; FILTER BAGS

Albany Felt Co	1373 Broadway, Albany 1	NY
AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
AMERICAN BRATTICE CLOTH CORP., Adv Pg 364	**Warsaw**	**Ind**
American Optical Co. Safety Products Div	98 Mechanic St. Southbridge	Mass
Bemis Bros. Bag Co	408 Pine St. St Louis 2	Mo
Chase Bag Co	355 Lexington Ave. New York 17	NY
Daniels, C. R., Inc	Daniels	Wd
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Equitable Paper Bag Co, Inc	45-50 Van Dam St. Long Island City 1	NY
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293	**East Moline**	**Ill**

Fram Corp	105 Pantucket Ave. E Providence	RI
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
National Powder Co	Eldred	Pa
Pendleton Woolen Mills	Box 655, Washougal	Wash
Peterson Filters & Engineering Co	1949 S 2 W, Salt Lake City 10	Utah

BALL MILLS *See* MILLS

BALLS *See* MILL BALLS

BARGES—*FLOATING*

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Meckum Engineering Inc	Dayton Rd. Ottawa	Ill
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont

BATTERIES—*STORAGE See* ELECTRIC BATTERIES—*DRY AND STORAGE*

BEARINGS—*BALL*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Fafnir Bearing Co	37 Booth St. New Britain	Conn
Federal-Mogul Service Div. Federal-Mogul-Bower Bearings, Inc	11031 Shoemaker, Detroit 13	Mich
Hoover Ball & Bearing Co	Box 1607, 5400 S State Rd. Ann Arbor	Mich
Kaydon Engineering Corp	Muskegon	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Marlin-Rockwell Corp	402 Chandler St. Jamestown	NY
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
New Departure Div. General Motors Corp	Bristol	Conn
Nice Ball Bearing Co	30th & Hunting Park Ave. Phila 40	Pa
Norma-Hoffman Bearings Corp	Stamford	Conn
SKF Industries Inc	Box 6731, Philadelphia 32	Pa
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**
Torrington Co	59 Field St. Torrington	Conn

BEARINGS—*NEEDLE*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Kaydon Engineering Corp	Muskegon	Mich
Orange Roller Bearing Co. Inc	557 Main St. Orange	NJ
Torrington Co	59 Field St. Torrington	Conn

BEARINGS—*PLAIN—NON-METALLIC*

Continental-Diamond Fibre Corp. Sub. Budd Co	Newark	Del
Johns-Manville	22 E 40 St. New York 16	NY
Ohio Carbon Co	12508 Berea Rd. Cleveland 11	Ohio
Stackpole Carbon Co	St Marys	Pa

BEARINGS—*PLAIN—OIL-IMPREGNATED & SINTERED METAL*

Dodge Mfg Corp	S Union St. Mishawaka	Ind
Federal-Mogul Service Div. Federal-Mogul-Bower Bearings, Inc	11031 Shoemaker, Detroit 13	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Olds Alloys Co	5601 E Imperial Hwy. South Gate	Cal
Saginaw Bearing Co	412 New Center Bld. Detroit	Mich

BEARINGS—*ROLLER*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Bower Roller Bearing Div. Federal-Mogul-Bower Bearings, Inc	3040 Hart Ave. Detroit 14	Mich
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Chain Belt Co. Shafer Bearing Div	Belmont Rd. at Curtiss St. Downers Grove	Ill
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Federal-Mogul Service Div. Federal-Mogul-Bower Bearings, Inc	11031 Shoemaker, Detroit 13	Mich
General Motors Corp. Hyatt Bearings Div	427 Middlesex St. Harrison	NJ
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Hoover Ball & Bearing Co	Box 1607, 5400 S State Rd. Ann Arbor	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Marlin-Rockwell Corp	402 Chandler St. Jamestown	NY
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
Norma-Hoffman Bearings Corp	Stamford	Conn
Orange Roller Bearing Co. Inc	557 Main St. Orange	NJ
Rollway Bearing Co. Inc	541 Seymour St. Syracuse 4	NY
SKF Industries Inc	Box 6731, Philadelphia 32	Pa
THE TIMKEN ROLLER BEARING CO., Adv. Pgs. 289, 4th Cover	**1835 Dueber Ave. Canton**	**Ohio**
Torrington Co	59 Field St. Torrington	Conn

BEARINGS—*SLEEVE*

American Crucible Products Co	1305 Oberlin Ave. Lorain	Ohio
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Federal-Mogul Service Div. Federal-Mogul-Bower Bearings, Inc	11031 Shoemaker, Detroit 13	Mich
Flood City Brass & Electric Co	Johnstown	Pa
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Ohio Carbon Co	12508 Berea Rd. Cleveland 11	Ohio
Olds Alloys Co	5601 E Imperial Hwy. South Gate	Cal
Saginaw Bearing Co	412 New Center Bld. Detroit	Mich

BEARINGS—*THRUST*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Chain Belt Co. Shafer Bearing Div	Belmont Rd. at Curtiss St. Downers Grove	Ill
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Federal-Mogul Service Div. Federal-Mogul-Bower Bearings, Inc	11031 Shoemaker, Detroit 13	Mich
Flood City Brass & Electric Co	Johnstown	Pa
Kaydon Engineering Corp	Muskegon	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Marlin-Rockwell Corp	402 Chandler St. Jamestown	NY
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
New Departure Div. General Motors Corp	Bristol	Conn
Nice Ball Bearing Co	30th & Hunting Park Ave. Phila 40	Pa
Norma-Hoffman Bearings Corp	Stamford	Conn
Orange Roller Bearing Co. Inc	557 Main St. Orange	NJ
Rollway Bearing Co. Inc	541 Seymour St. Syracuse 4	NY
Saginaw Bearing Co	412 New Center Bld. Detroit	Mich
SKF Industries Inc	Box 6731, Philadelphia 32	Pa
Stackpole Carbon Co	St Marys	Pa
Torrington Co	59 Field St. Torrington	Conn

BEARING METAL

Aluminum Co of America	1501 Alcoa Bldg. Pittsburgh 19	Pa
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
Ampco Metal, Inc	1739 S 38 St. Milwaukee 1	Wis
Belmont Smelting & Refining Works	330 Belmont Ave. Brooklyn 7	NY
Chase Brass & Copper Co	236 Grand St. Waterbury 20	Conn
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343	**P O Box 88, Pittsburgh 30**	**Pa**
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Olds Alloys Co	5601 E Imperial Hwy. South Gate	Cal

BEARING PILLOW BLOCKS—*HANGERS & JOURNAL BOXES*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Chain Belt Co. Shafer Bearing Div	Belmont Rd. at Curtiss St. Downers Grove	Ill
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Fafnir Bearing Co	37 Booth St. New Britain	Conn
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Hoover Ball & Bearing Co	Box 1607, 5400 S State Rd. Ann Arbor	Mich
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Marlin-Rockwell Corp	402 Chandler St. Jamestown	NY
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
New Departure Div. General Motors Corp	Bristol	Conn
Nice Ball Bearing Co	30th & Hunting Park Ave. Phila 40	Pa
Norma-Hoffman Bearings Corp	Stamford	Conn
Rogers Iron Works Co	Joplin	Mo
SKF Industries Inc	Box 6731, Philadelphia 32	Pa
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**
Torrington Co	59 Field St. Torrington	Conn
TREADWELL, H.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

BELT—*CONVEYOR SEE* CONVEYOR BELTING

BELT FASTENERS *See* FASTENERS—*BELT*

BELTS—*FLAT POWER TRANSMISSION*

AMERICAN BILTRITE RUBBER CO. BOSTON WOVEN HOSE & RUBBER DIV., Adv Pg 125	**Boston 3**	**Mass**
American Rubber Mfg Co	1145 Park Ave. Oakland 8	Cal
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Cincinnati Rubber Mfg Co Div, Thor Power Tool Co	Cincinnati 12	Ohio
Extremultus, Inc	25-11 40 Ave. Long Island City 1	NY
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lovejoy Flexible Coupling Co	4932 W Lake St. Chicago 44	Ill
Mercer Rubber Co	136 Mercer St. Trenton 90	NJ
H. K. Porter Co. Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**
Republic Rubber Div. Lee Rubber & Tire Corp	Albert St. Youngstown	Ohio
Rhoads, J. E., & Son	2100 N 11 St. Wilmington 99	Del
Thermoid Div. H. K. Porter Co. Inc	Whitehead Rd. Trenton 6	NJ

BELTS—"V"

AMERICAN BILTRITE RUBBER CO. BOSTON WOVEN HOSE & RUBBER DIV., Adv Pg 125	**Boston 3**	**Mass**
American Pulley Co	4200 Wissanicken Ave. Philadelphia 29	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
DAYCO CORP. DAYTON INDUSTRIAL PRODUCTS CO. DIV., Adv Pg 298	**2001 Jusico Ave. Melrose Park**	**Ill**
Dodge Mfg Corp	S Union St. Mishawaka	Ind
FLEXIBLE STEEL LACING CO., Adv Pg 366	**4607 Lexington St. Chicago 44**	**Ill**
Gates Rubber Co	999 S Broadway, Denver 17	Colo
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
Iowa Mfg Co	916 16 St. N.E. Cedar Rapids	Iowa
Lovejoy Flexible Coupling Co	4932 W Lake St. Chicago 44	Ill
Manheim Mfg & Belting Co	470 Stiegel St. Manheim	Pa
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
H. K. Porter Co. Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**
Republic Rubber Div. Lee Rubber & Tire Corp	Albert St. Youngstown	Ohio
Thermoid Div. H. K. Porter Co. Inc	Whitehead Rd. Trenton 6	NJ
U S Rubber Co. Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY

BELT DRESSING

Extremultus, Inc	29-11 40 Ave. Long Island City 1	NY
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Keystone Lubricating Co	21 & Clearfield Sts. Philadelphia 32	Pa
Rhoads, J. E., & Son	2100 W 11 St. Wilmington 99	Del

BIN & CHUTE GATES AND MECHANISMS *Also See* FEEDERS

Bonded Scale & Machine Co	38 Bellevue Ave. Columbus 7	Ohio
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
CHAIN BELT CO., Adv Pg 331	**469 W Greenfield Ave. Milwaukee 1**	**Wis**
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Coeur D'Alenes Co	Wallace	Idah
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Engineered Equipment, Inc	1001 Linden Ave. Waterloo	Iowa
Erie Strayer Co	Erie	Pa
Fairmont Machinery Co	Fairmont	W Va
Hack Engineering Co	124 Wazee Market, Denver	Colo
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Industrial Engineering & Construction Co	1st Natl Bank Bldg. Fairmont	W Va
Irwin Sensenich Corp	Box 311, Irwin	Pa
Jeffrey Mfg Co	686 N 4th St. Columbus 16	Ohio
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd. Ottawa	Ill
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
National Iron Co	Ramsey St. & 50 Ave. W, Duluth 7	Minn
Ogden Iron Works Co	185 23 St. Ogden	Utah
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Rogers Iron Works Co	Joplin	Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**
Thayer Scale	Pembroke	Mass
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa
Universal Road Machinery Co	Emerick St, Kingston	NY

BIN & HOPPERS—*BULK SOLIDS STORAGE-FOR LIQUIDS SEE* TANKS

BALDWIN-LIMA-HAMILTON. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**5 Main St. Lima**	**Mich**
BARBER-GREENE CO., Adv. Pgs. 168-169	**400 N Highland Ave. Aurora**	**Ill**
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Bin-Dicator Co	13946-300 Kercheval Ave. Detroit 15	Mich
Butler Mfg Co	1400 E 13 St. Kansas City 25	Mo
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Chicago Bridge & Iron Co	332 S Michigan Ave. Chicago 4	Ill
Coeur D'Alenes Co	Wallace	Idah
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Diamond Iron Works Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 329	**82 Beaver St. New York**	**NY**
Engineered Equipment, Inc	1001 Linden Ave. Waterloo	Iowa
Enterprise Wheel & Car Corp	Bristol	Va
Erie Strayer Co	Erie	Pa
Fairmont Machinery Co	Fairmont	W Va
Fluor Products Co	Box 1267, Santa Rosa	Cal
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hack Engineering Co	124 Wazee Market, Denver	Colo
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Industrial Engineering & Construction Co	1st Natl Bank Bldg. Fairmont	W Va
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
Irwin Sensenich Corp	Box 311, Irwin	Pa
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Lakeside Bridge & Steel Co	5305 N 33 St. Milwaukee 9	Wis
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Marietta Concrete Div. American-Marietta Co	Box 669, Dept. B, Marietta	Ohio
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd. Ottawa	Ill
NATIONAL IRON CO., Adv Pg 333	**Ramsey St. & 50 Ave. W, Duluth 7**	**Minn**
Ogden Iron Works Co	185 23 St. Ogden	Utah
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
SPANG & CO., Adv Pg 330	**143 Etna St. Butler**	**Pa**
Standard Steel Corp	5060 Boyle Ave. Los Angeles 58	Cal
STURTEVANT MILL CO., Adv Pg 362	**161 Clayton St. Boston 22**	**Mass**
TREADWELL, H.H., CO. INC., Adv Pg 75	**148 Cedar St. New York 6**	**NY**
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa
Universal Road Machinery Co	Emerick St, Kingston	NY

BINS & TANK-LEVEL INDICATORS *Also See* METERS & GAGES

Aerotec Industries, Inc	Greenwich	Conn
B-I-F Industries, Inc	345 Harris Ave. Providence 1	RI
Bin-Dicator Co	13946-300 Kercheval Ave. Detroit 15	Mich
Conrad, Inc	Box 9671, Pittsburgh 26	Pa
Erie Strayer Co	Erie	Pa
Fuller Co. Sub of General American Transportation Corp	Catasauqua	Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
HALLIBURTON CO., Adv Pg 123	**Denver 1431, Duncan**	**Okla**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Industrial Nucleonics Corp	650 Ackerman Rd. Columbus 2	Ohio
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362	**470 S 10 E, Salt Lake City 2**	**Utah**
Jeffrey Mfg Co	686 N 4th St. Columbus 16	Ohio
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Roberts & Schaefer Co Div. Thompson-Starrett Co. Inc	201 N Wells St. Chicago 6	Ill
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**

BITS *See* DRILL (ROCK) BITS

BLAST CLEANING EQUIPMENT

Norton Co	1 New Bond St. Worcester 6	Mass
Sly, W. W., Mfg Co	Box 5939, Cleveland 1	Ohio
STOODY CO., Adv Pg 334	**Box 901, Whittier**	**Cal**
Wheelabrator Corp	1474 S Byrkit St. Mishawaka	Ind

BLASTING ACCESSORIES & EQUIPMENT

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Power Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Coast Mfg & Supply Co	Box 71, Livermore	Cal
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
THE ENSIGN-BICKFORD CO., Adv Pg 53	**P O Box 308, Simsbury**	**Conn**
Hammond, J. V., Co	Spangler	Pa
Hammond, J. V., Co	Spangler	Pa
Heinrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Mayhew Machine & Supply Co	Box 7726, Dallas	Tex
National Fuse & Powder Co	3801 Delgany St. Denver 5	Colo
National Powder Co	Eldred	Pa
Salem Tool Co	Salem	Ohio
Trojan Powder Co	17 N 7th St. Allentown	Pa
Victor Equipment Co, Alloy Rod & Metal Div	13808 E Imperial Hwy, Norwalk	Cal

BLASTING AGENT PRIMERS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Spencer Chemical Co	Dwight Bldg, Kansas City 5	Mo
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING BAGS—*POWDER & TAMPING*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Bemis Bros. Bag Co	408 Pine St. St Louis 2	Mo
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Salem Tool Co	Salem	Ohio
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING COMPOUND CHARGERS—*PNEUMATIC*

AIR PLACEMENT EQUIPMENT CO., Adv Pg 346	**1008 W 25 St. Kansas City 8**	**Mo**
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Spencer Chemical Co	Dwight Bldg, Kansas City 5	Mo

BLASTING COMPOUND LOADING & RETRIEVING HOOKS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING COMPOUNDS—*AMMONIUM NITRATE AND OTHER UNCOMPOUNDED AGENTS*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Spencer Chemical Co	Dwight Bldg, Kansas City 5	Mo
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**

BLASTING COMPOUNDS—*BLACK POWDER*

ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
National Powder Co	Eldred	Pa

BLASTING COMPOUNDS—*BLASTING AGENTS (COMPOUNDED)*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING COMPOUNDS—*HIGH EXPLOSIVE-DYNAMITE-NITROGLYCERIN BASE*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DATCO CORP. DAYTON INDUSTRIAL PRODUCTS CO. DIV., Adv Pg 288	**2301 Jamico Ave. Melrose Park**	**Ill**
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa

BLASTING COMPOUNDS—*HIGH EXPLOSIVE-NON NITROGLYCERIN AND MILITARY TYPES*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING DETONATING CAP CRIMPERS *(HAND)*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Coast Mfg & Supply Co	Box 71, Livermore	Cal
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
THE ENSIGN-BICKFORD CO., Adv Pg 53	**P O Box 308, Simsbury**	**Conn**
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING DETONATING CAPS—*BOOSTERS & CONNECTORS*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Coast Mfg & Supply Co	Box 71, Livermore	Cal
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING FUSE LIGHTERS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Coast Mfg & Supply Co	Box 71, Livermore	Cal
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
THE ENSIGN-BICKFORD CO., Adv Pg 53	**P O Box 308, Simsbury**	**Conn**
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Fuse & Powder Co	3801 Delgany St. Denver 5	Colo
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING FUSES—*SAFETY DETONATING-ET AL*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Coast Mfg & Supply Co	Box 71, Livermore	Cal
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
THE ENSIGN-BICKFORD CO., Adv Pg 53	**P O Box 308, Simsbury**	**Conn**
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Fuse & Powder Co	3801 Delgany St. Denver 5	Colo
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING GALVANOMETERS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Special Instruments Laboratory Inc	312 W Vine Ave. Knoxville 2	Tenn
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING MACHINES—*ELECTRIC-BATTERY CONDENSER DISCHARGE*

Apache Powder Co	Benson	Ariz
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
Dyna Metric, Inc	2955 E Colorado Blvd. Pasadena	Cal
Heinrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING MACHINES—*ELECTRIC-HAND-PUSH GENERATOR*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co. Inc. Explosives Dept	2446 Nemours Bldg. Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St. Allentown	Pa

BLASTING SEISMOMETERS

Canadian Industries, Ltd	Box 10, Montreal	Can
Heinrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**

BLASTING STEMMING PLUGS *(TAMPING PLUGS)*

AIR PLACEMENT EQUIPMENT CO., Adv Pg 346	**1008 W 25 St. Kansas City 8**	**Mo**
Apache Powder Co	Benson	Ariz
Canadian Industries, Ltd	Box 10, Montreal	Can
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**

Trojan Powder Co	17 N 7th St, Allentown	Pa

BLASTING SWITCHES–*ELECTRIC POWER*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178–179	**Wilmington 99**	**Del**
DuPont De Nemours & Co, Inc. Explosives Dept.	2446 Nemours Bldg, Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St, Wilmington 99**	**Del**
Trojan Powder Co	17 N 7th St, Allentown	Pa

BLASTING TAMPING STICKS–*SECTIONAL*

Apache Powder Co	Benson	Ariz
Canadian Industries, Ltd	Box 10, Montreal	Can
HERCULES POWDER CO., Adv Pg 174	**910 Market St, Wilmington 99**	**Del**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St, Allentown	Pa

BLASTING WIRE *(LEADING & CONNECTING)*

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178–179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
Chester Cable Corp	Oakland Ave, Chester	NY
DuPont De Nemours & Co, Inc. Explosives Dept.	2446 Nemours Bldg, Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St, Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
The Okonite Co	220 Passaic St, Passaic	NJ
Rome Cable Div of Alcoa	330 Ridge St, Rome	NY
Trojan Powder Co	17 N 7th St, Allentown	Pa
VICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32–33	**575 Madison Ave, New York 22**	**NY**

BLASTING (LEG) WIRE CONNECTORS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Apache Powder Co	Benson	Ariz
ATLAS POWDER CO., Adv. Pgs. 178–179	**Wilmington 99**	**Del**
Canadian Industries, Ltd	Box 10, Montreal	Can
DuPont De Nemours & Co, Inc. Explosives Dept.	2446 Nemours Bldg, Wilmington 98	Del
HERCULES POWDER CO., Adv Pg 174	**910 Market St, Wilmington 99**	**Del**
National Powder Co	Eldred	Pa
Trojan Powder Co	17 N 7th St, Allentown	Pa

BLENDERS *See* **AGITATORS**

BLOCKS–*PULLEYS & SHEAVES See Also* SHEAVES–*MINE HOIST*

American Pulley Co	4200 Wissanicken Ave, Philadelphia 29	Pa
Bonded Scale & Machine Co	38 Bellevue Ave, Columbus 7	Ohio
Browning Mfg Co	Maysville	Ky
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave, Denver 4**	**Colo**
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
Dodge Mfg Corp	S Union St, Mishawaka	Ind
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Hammond, J. V., Co	Spangler	Pa
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
JOY MANUFACTURING CO., Adv. Pgs. 70–71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
National Supply Div, Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
New Departure Div, General Motors Corp	Bristol	Conn
Rope Master, Keeney, Paul E., Co	1125 SE Grand Ave, Portland 14	Ore
SAUERMAN BROS. INC., Adv Pg 326	**626 S 28 Ave, Bellwood**	**Ill**
Washington Iron Works	1500 6 Ave, S, Seattle 4	Wash

BLOWERS *See* **FANS; CONCRETE SPRAYERS; REFRACTORY PLACERS**

BLUE, PHOTO & WHITE PRINT MACHINES

Dyna Metric, Inc	2955 E Colorado Blvd, Pasadena	Cal
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Paragon-Revolute, Charles Bruning Co, Inc	77 South Ave, Rochester 4	NY
Frederick Post Co	3650 N Avondale Ave, Chicago 18	Ill

BOILERS & HEATERS–*LIQUID; DOES NOT INCLUDE* HEATERS–*SPACE; RETORTS*

American Standard Industrial Div	Detroit 32	Mich
Ames Iron Works, Inc	25 E 2 St, Oswego	NY
Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Carrier Corp	Carrier Pkwy, Syracuse 1	NY
Clayton Mfg Co	Box 550, El Monte	Cal
Keeler, E., Co	**238 West St, Williamsport 3**	**Pa**
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky

BOLTS *See* **FASTENERS; ROCK BOLTS**

BOOMS–*LOADING See* CRANES; CONVEYORS

BOOMS & TOWERS–*EXTENSIBLE & NOTILE–MOBILE & STATIONARY; DOES NOT INCLUDE* DRILL (ROCK) BOOMS; DRILL (ROCK) JUMBOS; BOOMS–*LOADING*

GARDNER DENVER CO., Adv. Pgs. 142–143	**Gardner Expwy, Quincy**	**Ill**
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Mobile Aerial Towers Inc	1730 N Harrison St, Fort Wayne	Ind
Schramm Inc	870 E Virginia Ave, West Chester	Pa
Washington Iron Works	1500 6 Ave, S, Seattle 4	Wash

BRAKES–*DYNAMIC Also See* BRAKES–*MAGNETIC*

Hillman, C. Kirk, Co, Inc	3201 First Ave, S, Seattle 4	Wash
Reliance Electric & Engineering	24701 Euclid Ave, Cleveland 17	Ohio

BRAKES–*FRICTION DISK & BLOCK*

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
American Chain & Cable Co, Automotive & Aircraft Div	601 Stephenson Bldg, Detroit 2	Mich
Cutler-Hammer, Inc	237 N 12 St, Milwaukee 1	Wis
GOODRICH, B.F., AVIATION PRODUCTS, Adv Pg 3	**500 S Main St, Akron**	**Ohio**
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
The Russell Mfg Co	Middletown	Conn
Thermoid Div. H. K. Porter Co, Inc	Whitehead Rd, Trenton 6	NJ

BRAKES–*MAGNETIC*

Clark Controller Co	1146 E 152 St, Cleveland 10	Ohio
Cutler-Hammer, Inc	237 N 12 St, Milwaukee 1	Wis
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352	**4716 W Electric Ave, Milwaukee 46**	**Wis**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Vickers Inc, Electric Products Div	1815 Locust St, St Louis 3	Mo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60–61, 150–151	**Box 2278, Pittsburgh 30**	**Pa**

BRATTICE CLOTH

AMERICAN BRATTICE CLOTH CORP., Adv Pg 364	**Warsaw**	**Ind**
Bemis Bros. Bag Co	408 Pine St, St Louis 2	Mo
Daniels, C. R., Inc	Daniels	Wd
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
Johnston-Morehouse-Dickey Co	704 Second Ave, Pittsburgh 19	Pa

BRUSHES

Helwig Co	2550 N 30 St, Milwaukee 10	Wis

BUCKETS–*BUCKETLINE DREDGE*

Erie Strayer Co	Erie	Pa
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Washington Iron Works	1500 6 Ave, S, Seattle 4	Wash

BUCKETS–*CLAMSHELL & GRAB*

Blaw-Knox Co	300 Sixth Ave, Pittsburgh 22	Pa
Coeur D'Alenes Co	Wallace	Idah
Drott Mfg Corp	3126 S 37 St, Milwaukee 15	Wis
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Erie Strayer Co	Erie	Pa
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Owen Bucket Co	6001 Breakwater Ave, Cleveland 2	Ohio
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Schield Bantam Co	221 Park St, Waverly	Iowa
Yaun Mfg Co, Inc	2120 N Third St, Baton Rouge	La

BUCKETS–*CONVEYOR & ELEVATOR; DOES NOT INCLUDE BUCKETS–TRAMWAY & TROLLEY*

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
BARBER-GREENE CO., Adv. Pgs. 168–169	**400 N Highland Ave, Aurora**	**Ill**
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Bonded Scale & Machine Co	38 Bellevue Ave, Columbus 7	Ohio
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
Christian, J. O., Engineers	480 Potrero Ave, San Francisco 10	Cal
Columbus Conveyor Co	869 W Goodale Blvd, Columbus 12	Ohio
Continental Conveyor & Equipment Co	P O Box 398, Winfield	Ala
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Enterprise Wheel & Car Corp	Bristol	Va
Erie Strayer Co	Erie	Pa
Fairmont Machinery Co	Fairmont	W Va
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Irwin Sensenich Corp	Box 311, Irwin	Pa
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
Laubenstein Mfg Co	422 S Third St, Ashland	Pa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St, Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Universal Engineering Corp	625 C Ave, NW, Cedar Rapids	Iowa
Universal Road Machinery Co	Emerick St, Kingston	NY
Watt Car & Wheel Co	Barnesville	Ohio

BUCKETS–*DIPPER SHOVEL*

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148–149	**389 E 14 St, Chicago Heights**	**Ill**
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Frog, Switch & Mfg Co	Carlisle	Pa
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130–131	**Marion**	**Ohio**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Quick-Way Truck Shovel Co	Box 1800, Denver 1	Colo
Schield Bantam Co	221 Park St, Waverly	Iowa
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can

BUCKETS–*DRAGLINE CRANE*

Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Hendrix Mfg Co	Box 31, Mansfield	La
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Page Engineering Co	Clearing Post Office, Chicago 38	Ill
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Quick-Way Truck Shovel Co	Box 1800, Denver 1	Colo
Schield Bantam Co	221 Park St, Waverly	Iowa
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
Yaun Mfg Co, Inc	2120 N Third St, Baton Rouge	La

BUCKETS–*DRAGLINE SCRAPER-SLUSHER*

Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
JOY MANUFACTURING CO., Adv. Pgs. 70–71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Page Engineering Co	Clearing Post Office, Chicago 38	Ill
SAUERMAN BROS. INC., Adv Pg 326	**626 S 28 Ave, Bellwood**	**Ill**
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
Taylor Wharton Div, Harsco Corp	High Bridge	NJ

BUCKETS–*HOISTING & SINKING; DOES NOT INCLUDE* SKIPS & CAGES

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave, Denver 4**	**Colo**
Coeur D'Alenes Co	Wallace	Idah
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
MATO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

BUCKETS–*TRAMWAY & TROLLEY*

Irwin Sensenich Corp	Box 311, Irwin	Pa
RIBLET TRAMWAY CO., Adv Pg 323	**P O Box 5220, Spokane 17**	**Wash**
Washington Iron Works	1500 6 Ave, S, Seattle 4	Wash

BUCKET TEETH & WEAR-REPLACEMENT PARTS

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56–57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148–149	**389 E 14 St, Chicago Heights**	**Ill**
American Steel Foundries	Prudential Plaza, Chicago 1	Ill
Case, J. I., Co, Industrial Div	700 State St, Racine	Wis
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Erie Strayer Co	Erie	Pa
Frog, Switch & Mfg Co	Carlisle	Pa
Haynes Stellite Co, Div, Union Carbide Corp	Kokomo	Ind
Ladish Co	5481 S Packard Ave, Cudahy	Wis
Manganese Steel Forge Co	Richmond & Castor Ave, Philadelphia	Pa
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130–131	**Marion**	**Ohio**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
Owen Bucket Co	6001 Breakwater Ave, Cleveland 2	Ohio
Page Engineering Co	Clearing Post Office, Chicago 38	Ill
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Schield Bantam Co	221 Park St, Waverly	Iowa
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
Stroh Process Steel Co	Calif & Marvista Aves, Pittsburgh 12	Pa
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Thomas Foundries Inc	Box 1111, Birmingham 1	Ala
Yaun Mfg Co, Inc	2120 N Third St, Baton Rouge	La

BUILDINGS–*PREFAB*

Armco Drainage & Metal Products	Middletown	Ohio
Butler Mfg Co	7400 E 13 St, Kansas City 26	Mo
Dresser-Ideco Co	975 Michigan Ave, Columbus 8	Ohio
Parkersburg Rig & Reel Co	620 Depot St, Parkersburg	W Va

BULLDOZERS & ANGLE DOZER BLADES *See* **TRACTOR ATTACHMENTS**

BURNERS–*OIL–GAS & COAL (FOR HEATERS–FURNACES–KILNS–ETC.)*

Babcock & Wilcox Co	141 E 42nd St, New York 17	NY
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
Surface Combustion Div, Midland-Ross Corp	2375 Dorr St, Toledo 1	Ohio

BURNERS–*HAND TORCH & MOBILE (FOR THAWING–WEED BURNING–ETC.) Also See* CAR THAWERS; *DOES NOT INCLUDE WELDING & CUTTING EQUIPMENT*

Hauck Mfg Co, Equipment Div	124–136 10 St, Brooklyn 15	NY

CABLE *See* **ELECTRICAL CABLE; WIRE ROPE**

CABLEWAYS *See* **AERIAL TRAMWAYS**

CAGES–*MINE HOIST See* SKIPS & CAGES

CALCULATORS *See* **COMPUTING MACHINES; DRAFTING EQUIP.; METERS; OFFICE MACHINES**

CAP LAMP CARBIDE

Columbus Conveyor Co	869 W Goodale Blvd, Columbus 12	Ohio
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo

CAP LAMPS–*CARBIDE*

Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo

CAP LAMPS–*ELECTRIC*

MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Nickel Alkaline Battery Div, The Electric Storage Battery Co	177 Main St, West Orange	NJ

CAR ACCESSORIES–*MINE & COMMERCIAL R.R. See BELOW; Also See* TRACK...; RAIL...

CAR (R.R.) BODIES

ACF Industries, Inc, American Car & Foundry Div	750 Third Ave, New York 17	NY
Baldwin-Lima-Hamilton Corp, Indl Eqpt Div	Philadelphia 42	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**

Differential Steel Car Co	Findlay	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
GENERAL AMERICAN TRANSPORTATION CORP.,		
Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**

CAR CAGERS & SPOTTERS *DOES NOT INCLUDE CAR MOVERS*

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
Flood City Brass & Electric Co	Johnstown	Pa
Nolan Co	120 Pennsylvania St. Bowerston	Ohio
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc	201 N Wells St. Chicago 6	Ill
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

CAR (R.R.) COUPLERS & DRAFT GEAR

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Enterprise Wheel & Car Corp	Bristol	Va
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
Ohio Brass Co	Mansfield	Ohio

CAR (R.R.) DERAILERS & RERAILERS & CHOCKS *DOES NOT INCLUDE SWITCHTYPE DERAILERS: See* RAIL SWITCHES

AMERICAN MINE DOOR CO., Adv Pg 324	**2039 Dreher Ave. SW, Canton 6**	**Ohio**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Frster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
Nolan Co	120 Pennsylvania St. Bowerston	Ohio
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn

CAR (& TRUCK) DUMPING DEVICES

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
Frank, M. K.	480 Lexington Ave. New York 17	NY
Heil Co—TEC Div	1285 W 70 St. Cleveland 2	Ohio
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
Marion Metal Products Co	Cheney Ave, Marion	Ohio
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
Roberts & Schaefer Co Div. Thompson-Starrett Co, Inc	201 N Wells St. Chicago 6	Ill
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

CAR (R.R.) MOVERS—*HAND*

Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**

CAR (R.R.) MOVERS—*SPECIAL TRACTOR TYPE*

Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
Hough, Frank G., Co	726 Seventh St. Libertyville	Ill
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65	**2301 N Adams St. Peoria**	**Ill**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
SIMPLEX WIRE & CABLE CO., Adv Pg 173	**79 Sidney St. Cambridge 39**	**Mass**
Whiting Corp	157 & Lathrop, Harvey	Ill

CAR (R.R.) MOVERS—*WINCH TYPE*

Fairmont Machinery Co	Fairmont	W Va
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Jeffrey Mfg Co	865 N 4th St. Columbus 16	Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Lidgerwood Mfg Co	7 Dey St. New York	NY
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
STEPHENS-ADAMSON MFG CO., Adv Pg 614	**260 Ridgeway Ave. Aurora**	**Ill**
Superior-Lidgerwood-Mundy Corp	1101 John Ave. Superior	Wis
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

CAR (R.R.) RETARDERS

American Brake Shoe Co	530 Fifth Ave. New York 36	NY
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
General Railway Signal Co	Rochester 2	NY
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
Union Switch & Signal Div. Westinghouse Air Brake Co	Swissvale	Pa

CAR & MOTOR TRUCK SHAKERS

Cleveland Vibrator Co	2828 Clinton Ave. Cleveland 13	Ohio
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**
Viber Co	726 S Flower, Burbank	Cal

CAR (R.R.) TRANSFERS—*PASSERS-ETC.*

AMERICAN MINE DOOR CO., Adv Pg 324	**2039 Dreher Ave. SW, Canton 6**	**Ohio**
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARDS, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Coeur D'Alenes Co	Wallace	Idah
Martin Engineering Co	Neponset	Ill
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**

CAR (R.R.) TRUCKS *Also See* CAR WHEELS

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
Frank, M. K.	480 Lexington Ave. New York 17	NY
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**

CAR (R.R.) TURNTABLES

Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Whiting Corp	157 & Lathrop, Harvey	Ill

CAR (& TRUCK) THAWERS

Hauck Mfg Co. Equipment Div	124-136 10 St. Brooklyn 15	NY
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**

CAR (& LOCOMOTIVE) WHEELS & AXLES

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Alco Products Inc	Dept. 915, Schenectady 5	NY
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
American Steel & Wire Div. U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
Baldwin-Lima-Hamilton Corp. Standard Steel Works Div	Burnham	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Columbia-Geneva Steel Div. U.S. Steel Corp	120 Montgomery St. San Francisco 6	Cal
Enterprise Wheel & Car Corp	Bristol	Va
Frank, M. K.	480 Lexington Ave. New York 17	NY
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
National Tube Div. U.S. Steel Corp	525 William Penn Pl. Pittsburgh	Pa
Penn Machine Co	905 H. K. Porter Bldg. Pittsburgh 19	Pa
Penn Machine Co	106 Station St. Johnstown	Pa
Penn Machine Co	P O Box 24, Huntington	W Va
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
Tool Steel Gear & Pinion Co	211 Township Ave. Cincinnati 16	Ohio
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Watt Car & Wheel Co	Barnesville	Ohio

CAR WHEEL & GEAR PULLERS

Owatonna Tool Co	655 Cedar St. Owatonna	Minn
Templeton, Kenly & Co	16th & Gardner Rd. Broadview	Ill

CARBIDES—*TUNGSTEN & OTHER HARD METALS (SINTERED-CEMENTED-ETC.)*

Adamas Carbide Corp	121 Market St. Kenilworth	NJ
Allegheny Ludlum Steel Corp	Oliver Bldg. Pittsburgh 22	Pa
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
Engelhard Industries, Inc	113 Astor St. Newark	NJ
Firth Sterling, Inc	3113 Forbes Ave, Pittsburgh 30	Pa
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Kennametal Inc. Mining Tool Div	Bedford	Pa
Long-Airdox Co. Marmon-Herrington Inc	P O Box 331, Oak Hill	W Va
Metal Carbides Corp	6001 Southern Blvd. Youngstown 12	Ohio
Metallugical Products Dept. General Electric Co	11177 E 8 Mile Rd. Detroit 32	Mich
Rexarc Inc. Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio
Sandvik Steel Inc	Fair Lawn	NJ
STOODY CO., Adv Pg 314	**Box 901, Whittier**	**Cal**
VASCOLOY-RAMET CORP., Adv Pg 134	**800 Market St. Waukegan**	**Ill**

CARS—*COMMERCIAL RAILROAD*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
GREENVILLE STEEL CAR CO., Adv Pg 39	**Greenville**	**Pa**
Magor Car Corp	660 Van Houten Ave. Clifton	NJ

CARS—*MINE R.R.-Also See SPECIFIC TYPES BELOW*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Irwin Sensenich Corp	Box 311, Irwin	Pa
Kersey Mfg Co. Inc	Box 151, Bluffield	Va
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
Ogden Iron Works Co	185 23 St. Ogden	Utah
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
Watt Car & Wheel Co	Barnesville	Ohio

CARS—*MINE & INDUSTRIAL R.R.-MAN & SPECIAL TYPES*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Coeur D'Alenes Co	Wallace	Idah
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Irwin Sensenich Corp	Box 311, Irwin	Pa
Kersey Mfg Co. Inc	Box 151, Bluffield	Va
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
Ogden Iron Works Co	185 23 St. Ogden	Utah
The Rockiron Co. Ltd.	P O Box 1085, Sudbury	Ont
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Watt Car & Wheel Co	Barnesville	Ohio

CARS—*MINE R.R. AUTOMATIC DUMP*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Coeur D'Alenes Co	Wallace	Idah
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Irwin Sensenich Corp	Box 311, Irwin	Pa
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
Watt Car & Wheel Co	Barnesville	Ohio
Wilkinson Co	437 N Columbia Blvd. Portland 17	Ore

CARS—*MINE R.R.-FIRE-Also See* FIRE FIGHTING EQUIPMENT

Frank, M. K.	480 Lexington Ave. New York 17	NY
Irwin Sensenich Corp	Box 311, Irwin	Pa
Watt Car & Wheel Co	Barnesville	Ohio

CARS—*MINE R.R.-HAND DUMP*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Coeur D'Alenes Co	Wallace	Idah
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Enterprise Wheel & Car Corp	Bristol	Va
Frank, M. K.	480 Lexington Ave. New York 17	NY
Irwin Sensenich Corp	Box 311, Irwin	Pa
Kersey Mfg Co. Inc	Box 151, Bluffield	Va
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Magor Car Corp	660 Van Houten Ave. Clifton	NJ
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
Ogden Iron Works Co	185 23 St. Ogden	Utah
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
The Rockiron Co. Ltd.	P O Box 1085, Sudbury	Ont
Watt Car & Wheel Co	Barnesville	Ohio

CARS—*MINE R.R. SELF-LOADING*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293	**East Moline**	**Ill**
Frank, M. K.	480 Lexington Ave. New York 17	NY
Irwin Sensenich Corp	Box 311, Irwin	Pa
Scott Aviation Corp	Lancaster	NY
Lake Shore Inc	P O Box 911, Iron Mountain	Mich

CARS—*SHUTTLE-See* TRUCKS

CASTING WHEELS—*SMELTER*

Engelhard Industries, Inc	113 Astor St. Newark	NJ
Gotham Brothers Manufacturing Co	Box 71, South Haven	Mich
Rogers Iron Works Co	Joplin	Mo
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Tool Steel Gear & Pinion Co	211 Township Ave. Cincinnati 16	Ohio
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28	**Mill St. Allentown**	**Pa**
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

CASTINGS—*IRON (GRAY-MALLEABLE ETC.)*

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Cast Iron Pipe Co	2930 16th St. N, Birmingham 2	Ala
American Chain Div. American Chain & Cable Co, Inc	York	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Cadillac Malleable Iron Co	Cadillac	Mich
Calumet Div. Calunet & Hecla, Inc	Calumet	Mich
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Carondelet Foundry Co	2101 S Kings Hwy. St Louis 10	Mo
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Crossley Machine Co	Mammoth & Bell Sts. Trenton	NJ

Davis Foundry & Machine Works	Old Furnace Rd. Rome	Ga
Engelhard Industries, Inc	113 Astor St. Newark	NJ
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
Enterprise Wheel & Car Corp	Bristol	Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
General Railway Signal Co	Rochester 2	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Irwin Sensenich Corp	Box 311, Irwin	Pa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 320	**Hollidaysburg**	**Pa**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
MEEHANITE METAL CORP., Adv Pg 337	**714 North Ave. New Rochelle**	**NY**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Rogers Iron Works Co	Joplin	Mo
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Washington Iron Works	1500 6 Ave. St, Seattle 4	Wash

CASTINGS–*FERROUS ALLOYS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
American Cast Iron Pipe Co	2930 16th St. N, Birmingham 2	Ala
Atlas Steels, Ltd	Welland, Ontario	Can
Babcock & Wilcox Co	161 E 42nd St. New York 17	NY
Baldwin-Lima-Hamilton Corp. Standard Steel Works Div	Burnham	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Cadillac Malleable Iron Co	Cadillac	Mich
Calumet Div. Calumet & Hecla, inc	Calumet	Mich
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Carondelet Foundry Co	2101 S Kings Hwy. St Louis 10	Mo
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Empire Steel Castings, Inc	Box 139, Reading	Pa
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
General Railway Signal Co	Rochester 2	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Lebanon Steel Foundry	Lebanon	Pa
MEEHANITE METAL CORP., Adv Pg 337	**714 North Ave. New Rochelle**	**NY**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
Ogden Iron Works Co	185 23 St. Ogden	Utah
Pacific Foundry & Metallurgy Co	3100 Nineteenth St. San Francisco 10	Cal
Rogers Iron Works Co	Joplin	Mo
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Sorel Steel Foundries Ltd	1405 Peel St. Montreal 2, P.Q.	Can
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Stroh Process Steel Co	Calif & Marvista Aves. Pittsburgh 12	Pa
Taylor Wharton Div. Harsco Corp	High Bridge	NJ
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

CASTINGS–*NONFERROUS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Aluminum Co of America	1501 Alcoa Bldg. Pittsburgh 19	Pa
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
American Curcible Products Co	1305 Oberlin Ave, Lorain	Ohio
Ampco Metal, Inc	1739 S 38 St, Milwaukee 1	Wis
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
Belmont Smelting & Refining Works	330 Belmont Ave. Brooklyn 7	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Calumet Div. Calumet & Hecla, Inc	Calumet	Mich
Elkhart Brass Mfg Co. Inc	1302 W Beardsley Ave. Elkhart	Ind
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
Enterprise Wheel & Car Corp	Bristol	Va
Flood City Brass & Electric Co	Johnstown	Pa
General Railway Signal Co	Rochester 2	NY
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Olds Alloys Co	5601 E Imperial Hwy. South Gate	Cal
STOODY CO., Adv Pg 314	**Box 901, Whittier**	**Cal**

CASTINGS–*STEEL*

American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Cast Iron Pipe Co	2930 16th St. N, Birmingham 2	Ala
American Steel Foundries	Prudential Plaza, Chicago 1	Ill
Baldwin-Lima-Hamilton Corp. Standard Steel Works Div	Burnham	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
BIRDSBORO CORP., Adv Pg 136	**Birdsboro**	**Pa**
Blaw-Knox Co	300 Sixth Ave. Pittsburgh 22	Pa
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Duniron Co, Inc	450 N Findlay St, Dayton 4	Ohio
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Empire Steel Castings, Inc	Box 139, Reading	Pa
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
Frog, Switch & Mfg Co	Carlisle	Pa
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
General Railway Signal Co	Rochester 2	NY
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Lebanon Steel Foundry	Lebanon	Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
Pacific Foundry & Metallurgy Co	3100 Nineteenth St. San Francisco 10	Cal
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill
Rogers Iron Works Co	Joplin	Mo
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Sorel Steel Foundries Ltd	1405 Peel St. Montreal 2, P.Q.	Can
Stroh Process Steel Co	Calif & Marvista Aves. Pittsburgh 12	Pa
Taylor Wharton Div. Harsco Corp	High Bridge	NJ
Thomas Foundries Inc	Box 1111, Birmingham 1	Ala
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

CHAIN–*CAST & WELDED*

American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Chain Div. American Chain & Cable Co. Inc	York	Pa
Bitco, Inc	Box 7646, Terminal Annex, Spokane 2	Wash
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
LOCKE STEEL CHAIN CO., Adv Pg 376	**Bridgeport**	**Conn**
Long-Airdox Co. Marmon-Herrington Inc	P O Box 331, Oak Hill	W Va
The McKay Co	1005 Liberty Ave. Pittsburgh 22	Pa
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
Olds Alloys Co	5601 E Imperial Hwy. South Gate	Cal
Page Engineering Co	Clearing Post Office, Chicago 38	Ill
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Taylor Wharton Div. Harsco Corp	High Bridge	NJ

CHAIN–*POWER TRANSMISSION*

American Brake Shoe Co	530 Fifth Ave. New York 36	NY
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Columbus McKinnon Corp. Mining Equipment Div	56 Fremont Ave. Tonawanda	NY
Diamond Chain Co, Inc	452 Kentucky Ave, Indianapolis 7	Ind
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Morse Chain Co. Borg-Warner Industry	Ithaca	NY
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**

CHAIN FITTINGS & ACCESSORIES

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Chain Div. American Chain & Cable Co. Inc	York	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Interstate Drop Forge Co. Special Products Div	4051 N 27 St. Milwaukee 16	Wis
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
The McKay Co	1005 Liberty Ave. Pittsburgh 22	Pa
Morse Chain Co. Borg-Warner Industry	Ithaca	NY
Sorel Steel Foundries Ltd	1405 Peel St. Montreal 2, P.Q.	Can
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**

CHAIN SLINGS

American Chain Div. American Chain & Cable Co. Inc	York	Pa
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Columbus McKinnon Corp. Mining Equipment Div	56 Fremont Ave. Tonawanda	NY
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
The McKay Co	1005 Liberty Ave. Pittsburgh 22	Pa
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill

CHAIN SPROCKETS–*See GEARS*

CHEMICAL LABORATORY EQUIPMENT & SUPPLIES–*DOES NOT INCLUDE CHEMICALS Also See METERS–LABORATORY & SCIENTIFIC INSTRUMENTS OTHER THAN...ETC.*

Beckman Instruments, Inc. Scientific & Process Instruments Div	2500 Harbor Blvd. Fullerton	Cal
Bico, Inc	Box 3086, Glenoaks Sta. Burbank	Cal
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Cahn Instrument Corp	14511 Paramount Blvd, Paramount	Cal
COORS PORCELAIN CO., Adv Pg 138	**600 Ninth St. Golden**	**Colo**
Curtiss-Wright Corp	Box 110, Princeton	NJ
Fisher Scientific Co	717 Forbes Ave. Pittsburgh 19	Pa
HALLIBURTON CO., Adv Pg 123	**Denver 1431, Duncan**	**Okla**
Laboratory Equipment Corp	Lakeview & Hilltop, St Joseph	Mich
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
Scott Williams Mineral Co, Inc	440 N Scottsdale Rd. Scottsdale	Ariz
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**

CHEMICALS–*Also See FLOTATION REAGENTS; WATER TREATMENT CHEMICALS*

Allied Chemical Corp. Solvay Process Div	61 Broadway, New York 6	NY
AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
AMERICAN POTASH & CHEMICAL CO., Adv Pg 62	**3000 W 6 St. Los Angeles 54**	**Cal**
Arizona Chemical Co	30 Rockefeller Plaza, New York 20	NY
Armour Industrial Chemical Co	110 N Wacker Dr. Chicago 6	Ill
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Baker & Adamson Products, General Chemical Div, Allied Chemical Corp	40 Rector St. New York 6	NY
J. T. Baker Chemical Co	Phillipsburg	NJ
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Burtonite Co	330 Passaic Ave. Nutley 10	NJ
Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Dow Corning Corp	Midland	Mich
Emery Industries, Inc	Carew Tower, Cincinnati 2	Ohio
Food Machinery & Chemical Corp. Mineral Products Div, Chlor-Alkali Div	161 E 42 St. New York 17	NY
Freeport Sulphur Co	161 E 42 St. New York	NY
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
Ionac Chemical Co. Div, Pfaudler Permutit Inc	Birmingham	NJ
Marathon Div, American Can Co. Chemical Sales Dept	Menasha	Wis
Minnesota Mining & Mfg Co	900 Bush Ave. St Paul 6	Minn
Pacific Lumber Co	100 Bush St. San Francisco 4	Cal
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
PHELPS DODGE REFINING CORP., Adv Pg 368	**300 Park Ave. New York 22**	**NY**
PHILADELPHIA QUARTZ CO., Adv Pg 376	**1135 Public Ledger Bldg. Phila 6**	**Pa**
Rohn & Haas Co	222 W Washington Sq, Philadelphia 5	Pa
Stein, Hall & Co, Inc	285 Madison Ave, New York 17	NY
Tennessee Corp	Grant Bldg, Atlanta	Ga
Texas Gulf Sulphur Co	75 E 45 St. New York	NY
Wyandotte Chemicals Corp, Michigan Alkali Div	Wyandotte	Mich

CLASSIFIERS–*See BELOW; Also See DUST COLLECTORS & PRECIPITATORS; FILTERS; SEPARATORS; SCREENS; SCRUBBERS; THICKENERS*

CLASSIFIERS–*CYCLONE-DRY*

BUELL ENGINEERING CO., Adv Pg 154	**123 William St. New York 38**	**NY**
Combustion Engineering, Inc	200 Madison Ave. New York 16	NY
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Research-Cottrell Inc	Bound Brook	NJ
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc	201 N Wells St. Chicago 6	Ill
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 67 & 338	**1000 W 9 St. Los Angeles 15**	**Cal**

CLASSIFIERS–*CYCLONE-WET*

Bird Machine Co	South Walpole	Mass
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
EQUIPMENT ENGINEERS INC., Adv Pg 111	**737 Loma Verde, Palo Alto**	**Cal**
Fairmont Machinery Co	Fairmont	W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc	201 N Wells St. Chicago 6	Ill
Western Machinery Co. Wemco Div	650 Fifth St. San Francisco 7	Cal

CLASSIFIERS–*MECHANICAL-DRY-CENTRIFUGAL IMPELLER*

BUELL ENGINEERING CO., Adv Pg 154	**123 William St. New York 38**	**NY**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Majac Inc	23rd St. Pittsburgh 15	Pa
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**
Universal Road Machinery Co	Emerick St. Kingston	NY

CLASSIFIERS–*MECHANICAL-WET-BELT (CLEATED & PLAIN)*

DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**

CLASSIFIERS–*MECHANICAL-WET-CENTRIFUGE*

Bird Machine Co	South Walpole	Mass
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**

CLASSIFIERS–*MECHANICAL-WET-CENTRIFUGAL IMPELLER*

DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**

CLASSIFIERS–*MECHANICAL-WET-RAKE-BOWL*

DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Morse Bros Machinery Co	7900 Brighton Blvd, Denver	Colo

CLASSIFIERS–*MECHANICAL-WET-RAKE-MULTI-DRAG-SCRAPER*

DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn

CLASSIFIERS–*MECHANICAL-WET-RAKE-RECIPROCATING HOE*

DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill

CLASSIFIERS–*MECHANICAL-WET-RAKE-ULTRA-SONIC*

Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill

CLASSIFIERS–*SPIRAL-SCREW*

Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Eagle Iron Works	262 Holcomb Ave. Des Moines 4	Iowa
Hack Engineering Co	124 Wazee Market, Denver	Colo
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 320	**Hollidaysburg**	**Pa**
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave. SE, Minneapolis 14	Minn
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr. Milwaukee 12	Wis
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Western Machinery Co. Wemco Div	650 Fifth St. San Francisco 7	Cal

CLASSIFIERS–*WET-HINDERED SETTLING*

Bird Machine Co	South Walpole	Mass
DEISTER CONCENTRATOR CO. INC., Adv Pg 302	**903 Glasgow Ave. Ft Wayne**	**Ind**
DEISTER MACHINE CO., Adv Pg 358	**1933 E Wayne St. Fort Wayne**	**Ind**

DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc	201 N Wells St, Chicago 6	Ill
Western Machinery Co, Wemco Div	650 Fifth St, San Francisco 7	Cal

CLASSIFIERS–*WET-SETTLING-BOWL OR TANK*

DORR OLIVER INC., Adv. Pgs. 8-9	**Hervanger Ln, Stamford**	**Conn**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St, York**	**Pa**
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 328	**Hollidaysburg**	**Pa**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc	201 N Wells St, Chicago 6	Ill
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr, Milwaukee 12	Wis

CLASSIFIERS–*WET-SLUICING–See* SEPARATORS–*SLUICE*

CLOTH & FABRICS–*Also See* BAGS; BRATTICE CLOTH; FILTER CLOTH; INSULATION CLOTH; TARPAULINS; VENTILATION TUBING; WIRE CLOTH

Albany Felt Co	1373 Broadway, Albany 1	NY
Bemis Bros. Bag Co	**408 Pine St, St Louis 2**	**Mo**
Cambridge Wire Cloth Co	152 Linkwood Rd, Cambridge	Md
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Daniels, C. R., Inc	Daniels	Md
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2446 Nemours Bldg, Wilmington**	**Del**
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293	**East Moline**	**Ill**
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Metal Goods Corp	8800 Page Blvd, St Louis 14	Mo
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
National Filter Media Corp	1717 Dixwell Ave, New Haven 11	Conn
Pendleton Woolen Mills	Box 655, Washougal	Wash
Peterson Filters & Engineering Co	1949 S 2 W, Salt Lake City 10	Utah
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Wellington Sears Co	111 W 40 St, New York 18	NY
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave, New York 22**	**NY**

CLOTHING–See SAFETY CLOTHING

CLUTCHES–*FLUID–See* DRIVES–*FLUID*

CLUTCHES–*FRICTION*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Central Mine Equipment Co	6200 N Broadway, St Louis 15	Mo
Dodge Mfg Corp	S Union St, Mishawaka	Ind
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Morse Chain Co, Borg-Warner Industry	Ithaca	NY
New Departure Div, General Motors Corp	Bristol	Conn
Twin Disc Clutch Co	Racine	Wis
Thermoid Div, H. K. Porter Co, Inc	Whitehead Rd, Trenton 6	NJ
Tool Steel Gear & Pinion Co	211 Township Ave, Cincinnati 16	Ohio
Twin Disc Clutch Co	Racine	Wis

CLUTCHES–*MAGNETIC–See* DRIVES–*MAGNETIC*

COATINGS–*ABRASION-RESISTANT-NON-METALLIC-DOES NOT INCLUDE LININGS & CLADDINGS*

Alpha Molykote Corp	65 Harvard St, Stamford	Conn
American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Armour Industrial Chemical Co	110 N Wacker Dr, Chicago 6	Ill
Canadian Industries, Ltd	Box 10, Montreal	Can
Carboline Co	32 Hanley Ind. Ct, St Louis 17	Mo
COORS PORCELAIN CO., Adv Pg 138	**600 Ninth St, Golden**	**Colo**
Eagle - Picher Co	American Bldg, Cincinnati 1	Ohio
Gallagher Co	Box 209, Salt Lake City 10	Utah
Gates Engineering Co	100 S West St, Wilmington 99	Del
LIKATEX CORP OF AMERICA, Adv Pg 139	**P O Drawer D, Stafford Springs**	**Conn**
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Norton Co	1 New Bond St, Worcester 6	Mass
Sherwin-Williams Co	101 Prospect Ave, NW, Cleveland 1	Ohio
STANDARD OIL CO OF CALIFORNIA, WESTERN OPERATIONS INC., Adv Pg 35	**225 Bush St, San Francisco 20**	**Cal**

COATINGS–*CHEMICAL & CORROSION-RESISTANT-METALLIC–Also See* METALIZING; *DOES NOT INCLUDE LININGS & CLADDINGS*

Amercoat Corp	4809 Firestone Blvd, South Gate	Cal
American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
AMERICAN SMELTING & REFINING CO. FEDERATED METALS DIV., Adv Pg 319	**120 Broadway, New York 5**	**NY**
Canadian Industries, Ltd	Box 10, Montreal	Can
Carboline Co	32 Hanley Ind. Ct, St Louis 17	Mo
Carbolineum Wood Preserving Co	6683 N 40th St, Milwaukee 9	Wis
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St, Chicago 3**	**Ill**
Goodall Rubber Co	Whitehead Rd, Trenton	NJ
Haynes Stellite Co, Div, Union Carbide Corp	Kokomo	Ind
Ionics Inc	152 Sixth St, Cambridge 42	Mass
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Sherwin-Williams Co	101 Prospect Ave, NW, Cleveland 1	Ohio
Solar Aircraft Co	2200 Pacific Hwy, San Diego 12	Cal
Solar Aircraft Co	2200 Pacific Hwy, San Diego 12	Cal
U S Stoneware Co	Akron 9	Ohio

COATINGS–*CHEMICAL & CORROSION-RESISTANT-NON-METALLIC-DOES NOT INCLUDE LININGS & CLADDINGS: PAINTS*

Amercoat Corp	4809 Firestone Blvd, South Gate	Cal
American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Atlantic Refining Co	260 S Broad St, Philadelphia	Pa
Canadian Industries, Ltd	Box 10, Montreal	Can
Carboline Co	32 Hanley Ind. Ct, St Louis 17	Mo
Carey, Philip, Mfg Co	320 S Wayne Ave, Cincinnati 15	Ohio
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2446 Nemours Bldg, Wilmington**	**Del**
Eagle - Picher Co	American Bldg, Cincinnati 1	Ohio
Esso Standard Div, Humble Oil & Refining Co	15 W 51 St, New York 19	NY
Gallagher Co	Box 209, Salt Lake City 10	Utah
Gates Engineering Co	100 S West St, Wilmington 99	Del
Keystone Lubricating Co	21 & Clearfield Sts, Philadelphia 32	Pa
Mercer Rubber Co	136 Mercer St, Trenton 90	NJ
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Norton Co	1 New Bond St, Worcester 6	Mass
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
PHILADELPHIA QUARTZ CO., Adv Pg 326	**1135 Public Ledger Bldg, Phila 6**	**Pa**
Ruberoid Co	500 Fifth Ave, New York 36	NY
Sherwin-Williams Co	101 Prospect Ave, NW, Cleveland 1	Ohio
Sika Chemical Corp	35 Gregory Ave, Passaic	NJ
U S Stoneware Co	Akron 9	Ohio

COMMUNICATIONS–*AUDIBLE SIGNAL*

Falcon Alarm Co, Inc	243 Broad St, Summit	NJ
Scott Aviation Corp	Lancaster	NY
Talk-A-Phone Co	5013 N Kedzie Ave, Chicago 25	Ill

BELL–*BUZZER–HORN–ETC. Also See BELOW*

COMMUNICATIONS–*RADIO*

AGA Corp of America	P O Box 447, South Plainfield	NJ
Dresser-Ideco Co	975 Michigan Ave, Columbus 8	Ohio
Globe Electronics, A Div of Textron Electronics, Inc	22-30 S 34 St, Council Bluffs	Iowa
ITT Federal Laboratories Div of International Tel & Tel Corp	500 Washington Ave, Nutley	NJ
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362	**478 S 10 E, Salt Lake City 2**	**Utah**
Motorola Communications & Electronics Inc	4501 Augusta Blvd, Chicago 51	Ill
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Radio Corp of America, Communications Products Dept	Camden 2	NJ
Seiscor, a Div of Seismograph Service Corp	Box 1590, Tulsa 1	Okla

COMMUNICATIONS–*TELEPHONE*

Dresser-Ideco Co	975 Michigan Ave, Columbus 8	Ohio
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362	**478 S 10 E, Salt Lake City 2**	**Utah**
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
Seiscor, a Div of Seismograph Service Corp	Box 1590, Tulsa 1	Okla
Talk-A-Phone Co	5013 N Kedzie Ave, Chicago 25	Ill

COMMUNICATIONS–*TELEVISION*

Dage Div, Thompson, Rano, Wooldridge, Inc	455 Sheridan Ave, Michigan City	Ind
Dresser-Ideco Co	975 Michigan Ave, Columbus 8	Ohio
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
Motorola Communications & Electronics Inc	4501 Augusta Blvd, Chicago 51	Ill
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**

COMMUNICATIONS–*VISUAL SIGNAL (LIGHTS–SEMAPHORE–ETC.)–Also See ABOVE AND RAIL SIGNALS; DOES NOT INCLUDE SIGNS)*

AMERICAN MINE DOOR CO., Adv Pg 324	**3939 Dunbar Ave, SW, Canton 6**	**Ohio**
CHEATHAM ELECTRIC SWITCHING DEVICE CO., Adv Pg 356	**4700 Crittenden Dr, Louisville 9**	**Ky**
Dresser-Ideco Co	975 Michigan Ave, Columbus 8	Ohio
General Railway Signal Co	Rochester 2	NY
National Powder Co	Eldred	Pa
NACHOD & U S SIGNAL CO., Adv Pg 354	**4777 Louisville Ave, Louisville 9**	**Ky**
Union Switch & Signal Div, Westinghouse Air Brake Co	Swissvale	Pa

COMPUTING MACHINES–*DOES NOT INCLUDE SLIDE RULES (SEE* DRAFTING EQUIP.)

General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Geo-Optic & Paper Corp	149 Church St, New York 7	NY
Geodynamics, Inc	Box 1258, 1543 3rd St, Santa Monica	Cal
Remington Rand Div, Sperry Rand Corp	315 Park Ave, S, New York 10	NY

CONCENTRATORS–See SEPARATORS & CONCENTRATORS *INCLUDING* ELECTROSTATIC; HEAVY MEDIA; JIGS; TABLES; MAGNETIC AND SPIRAL

CONCRETE ADDITIVES *(DISPERSANTS–ANTI-FREEZE–ETC.)*

Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Burtonite Co	390 Passaic Ave, Nutley 10	NJ
Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Eagle - Picher Co	American Bldg, Cincinnati 1	Ohio
HALLIBURTON CO., Adv Pg 123	**Drawer 1431, Duncan**	**Okla**
HERCULES POWDER CO., Adv Pg 174	**910 Market St, Wilmington 99**	**Del**
Intrusion-Prepakt Inc	568 Union Commerce Bldg, Cleveland 14	Ohio
Johns-Manville	22 E 40 St, New York 16	NY
Marathon Div, American Can Co, Chemical Sales Dept	Menasha	Wis
Master Builders Co	2490 Lee Blvd, Cleveland 18	Ohio
NEWPORT CHEMICAL CORP., Adv Pg 321	**342 Madison Ave, New York 17**	**NY**
NEWPORT INDUSTRIES DIV. HEYDEN		
Sika Chemical Corp	35 Gregory Ave, Passaic	NJ
Wyandotte Chemicals Corp, Michigan Alkali Div	Wyandotte	Mich

CONCRETE FORMS *(PREFAB–MOVABLE–ETC.)*

Acrow Corp of America	231 Washington Ave, Carlstadt	NJ
Blaw-Knox Co	300 Sixth Ave, Pittsburgh 22	Pa
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**

CONCRETE GROUT PUMPS

AIR PLACEMENT EQUIPMENT CO., Adv Pg 346	**1000 W 25 St, Kansas City 8**	**Mo**
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy, Quincy**	**Ill**
HALLIBURTON CO., Adv Pg 123	**Drawer 1431, Duncan**	**Okla**
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
Morris Machine Works	Baldwinsville	NY
SPRAGUE & HENWOOD INC., Adv Pg 146	**221 W Olive St, Scranton**	**Pa**

CONCRETE (& SIMILAR MATERIAL) PUMPS–*SLINGERS & PLACERS*

AIR PLACEMENT EQUIPMENT CO., 346	**1000 W 25 St, Kansas City 8**	**Mo**
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
Morris Machine Works	Baldwinsville	NY
Robbins & Myers Inc	1345 Lagonda Ave, Springfield	Ohio

CONCRETE SPRAYERS & BLOWERS

AIR PLACEMENT EQUIPMENT CO., Adv Pg 356	**1000 W 25 St, Kansas City 8**	**Mo**
Allentown Pneumatic Gun Co	1520 Walnut St, Allentown	Pa
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Sika Chemical Corp	35 Gregory Ave, Passaic	NJ

CONDENSERS–See COOLERS

CONSULTANTS–See CONTRACTORS: LABORATORY SERVICE:

CONTINUOUS MINERS & PLANERS–*Also See* DRILLS (ROCK) SPECIAL LARGE; *DOES NOT INCLUDE CUTTING MACHINES; FOR BITS–See* CUTTING MACHINE BITS

Coeur D'Alenes Co	Wallace	Idah
Goodman Mfg Co	Halsted St. & 48th Pl, Chicago 9	Ill
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
KRUPP, FRIED., Adv Pg 176	**Maschinen-und-Stahlbau, Rheinhausen-Niederrhein**	**Ger**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**

CONTRACTORS–*AERIAL SURVEY (EXPLORATION–MAPPING–ETC.)*

Abrams Aerial Survey Corp	606 Shawassee St, Lansing	Mich
AERO SERVICE CORP., Adv Pg 172	**210 E Courtland St, Philadelphia 20**	**Pa**
Aero Service Corp, (Mid-Continent)	1401 S Detroit St, Tulsa	Okla
Aero Service Corp, (Western)	157 W 9th South, Salt Lake City 1	Utah
Airborne Explorers Limited	P O Box 129, Willowdale	Ont
American Air Surveys, Inc	907 Penn Ave, Pittsburgh 22	Pa
Ameann, Jack, Inc, Engineers & Surveyors	931 Broadway, San Antonio	Tex
Canadian Aero Service Ltd	348 Queen St, Ottawa, Ontario	Can
Fairchild Aerial Surveys	224 E 11 St, Los Angeles	Cal
Geodynamics, Inc	Box 1258, 1543 3rd St, Santa Monica	Cal
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
Hunting Survey Corp, Ltd	1450 O'Conner Dr, Toronto 18	Can
Hunting Surveys, Inc	10 Rockefeller Plaza, New York 20	NY
Hunting Surveys, Ltd	6 Elstree Way, Boreham Wood, London	Eng
KELLOGG EXPLORATION CO., Adv Pg 344	**3301 N Marengo Ave, Altadena**	**Cal**

CONTRACTORS–*CONSTRUCTION–MINERAL PROCESSING PLANT*

BECHTAL CORP., Adv Pg 175	**220 Bush St, San Francisco 4**	**Cal**
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Chemical Construction Corp	320 Park Ave, New York 22	NY
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Foley Brothers, Inc	Pleasantville	NY
Hack Engineering Co	124 Wazee Market, Denver	Colo
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
Industrial Engineering & Construction Co	1st Natl Bank Bldg, Fairmont	W Va
KAISER ENGINEERS, Adv. Pgs. 73 & 115	**Kaiser Center, Oakland 12**	**Cal**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave, NE, Cleveland 14**	**Ohio**
Singmaster & Breyer Inc	420 Lexington Ave, New York 17	NY
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St, Denver 17**	**Colo**
Stone & Webster Engineering Corp	90 Broad St, New York 4	NY
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Walvoord, O. W., Inc	301 Detroit St, Denver 6	Colo

CONTRACTORS–*CONSTRUCTION–PIERS & WHARVES–ORE HANDLING ET AL*

BECHTAL CORP., Adv Pg 175	**220 Bush St, San Francisco 4**	**Cal**
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Foley Brothers, Inc	Pleasantville	NY
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
Intrusion-Prepakt Inc	568 Union Commerce Bldg, Cleveland 14	Ohio
KAISER ENGINEERS, Adv. Pgs. 73 & 115	**Kaiser Center, Oakland 12**	**Cal**
KELLOGG, M.W., CO. DIV. PULLMAN INC., Adv Pg 344	**711 Third Ave, New York 17**	**NY**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave, NE, Cleveland 14**	**Ohio**
Singmaster & Breyer Inc	420 Lexington Ave, New York 17	NY
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St, Denver 17**	**Colo**
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**

CONTRACTORS–*CONSTRUCTION–SHAFT & TUNNEL*

Dravo Corp	Neville Island, Pittsburgh 25	Pa
Foley Brothers, Inc	Pleasantville	NY
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
Intrusion-Prepakt Inc	568 Union Commerce Bldg, Cleveland 14	Ohio
KAISER ENGINEERS, Adv. Pgs. 73 & 115	**Kaiser Center, Oakland 12**	**Cal**

CONTRACTORS–*DESIGN–MINE*

BECHTAL CORP., Adv Pg 175	**220 Bush St, San Francisco 4**	**Cal**
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
KAISER ENGINEERS, Adv. Pgs. 73 & 115	**Kaiser Center, Oakland 12**	**Cal**
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St, Denver 17**	**Colo**

CONTRACTORS–*DESIGN MINERAL PROCESSING PLANT*

BECHTAL CORP., Adv Pg 175	**220 Bush St, San Francisco 4**	**Cal**
Blaw-Knox Co	300 Sixth Ave, Pittsburgh 22	Pa
Booth Co, Inc	333 W 14 S, Salt Lake City 15	Utah
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Chemical Construction Corp	320 Park Ave, New York 22	NY
Chemical Separations Corp	Box 1031, Oak Ridge	Tenn
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Fairmont Machinery Co	Fairmont	W Va
Gallagher Co	Box 209, Salt Lake City 10	Utah
Gould Gordon L., Co	58 Sutter St, San Francisco 4	Cal
Hack Engineering Co	124 Wazee Market, Denver	Colo
Hesnrichs Geoexploration Co	P O Box 5671, Tucson	Ariz
Industrial Engineering & Construction Co	1st Natl Bank Bldg, Fairmont	W Va
KAISER ENGINEERS, Adv. Pgs. 73 & 115	**Kaiser Center, Oakland 12**	**Cal**

KELLOGG, M.W., CO. DIV. PULLMAN INC.,
Adv Pg 344 ... **711 Third Ave. New York 17** ... **NY**

McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ... **113 St Clair Ave. NE, Cleveland 14** ... **Ohio**

Singmaster & Breyer Inc ... 420 Lexington Ave, New York 17 ... NY
Southwestern Engineering Co ... 4800 Santa Fe Ave, Los Angeles 58 ... Cal
STEARNS ROGER MFG CO., Adv Pg 291 ... **660 Bannock St. Denver 17** ... **Colo**
Stone & Webster Engineering Corp ... 90 Broad St, New York 4 ... NY
TREADWELL, M.H., CO. INC., Adv Pg 75 ... **140 Cedar St. New York 6** ... **NY**
U S STEEL CORP., Adv. Pgs. 12, 280 ... **525 Wm Penn Pl. Pittsburgh 30** ... **Pa**
Universal Dredge Mfg Co ... 124 Wazee Market, Denver 4 ... Colo
Walvoord, D. W., Inc ... 301 Detroit St. Denver 6 ... Colo

CONTRACTORS–*DRILLING (EXPLORATION)*

BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... **1275-1291 Parker St. Vancouver 6** ... **Can**
Carpco Research & Engineering, Inc ... P O Box 3272, Jacksonville 6 ... Fla
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... **333 Henry W Oliver Bldg. Pittsburgh 22** ... **Pa**
Longyear Co ... 76 S 8th St, Minneapolis 2 ... Minn
McClintock Co ... W 418 Second Ave, Spokane ... Wash
SPRAGUE & HENWOOD INC., Adv Pg 146 ... **221 W Olive St. Scranton** ... **Pa**

CONTRACTORS–*GEOLOGICAL SERVICE*

Canadian Aero Service Ltd ... 348 Queen St, Ottawa, Ontario ... Can
Geodynamics, Inc ... Box 1258, 1543 3rd St, Santa Monica ... Cal
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Hunting Survey Corp, Ltd ... 1450 O'Conner Dr, Toronto 16 ... Can
Hunting Surveys, Inc ... 10 Rockefeller Plaza, New York 20 ... NY
Hunting Surveys, Ltd ... 6 Elstree Way, Boreham Wood, London ... Eng
KELLOGG EXPLORATION CO., Adv Pg 344 ... **3301 N Marengo Ave. Altadena** ... **Cal**
Longyear Co ... 76 S 8th St, Minneapolis 2 ... Minn

CONTRACTORS–*GEOPHYSICAL SERVICE*

AERO SERVICE CORP., Adv Pg 172 ... **210 E Courtland St. Philadelphia 20** ... **Pa**
Aero Service Corp, (Mid-Continent) ... 1401 S Detroit St, Tulsa ... Okla
Aero Service Corp, (Western) ... 157 W 9th South, Salt Lake City 1 ... Utah
Airborne Explorers Limited ... P O Box 129, Willowdale ... Ont
Canadian Aero Service Ltd ... 348 Queen St, Ottawa, Ontario ... Can
Geodynamics, Inc ... Box 1258, 1543 3rd St, Santa Monica ... Cal
Geophysical Specialties, Co ... 15409 Robinwood Dr, Hopkins ... Minn
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Hunting Survey Corp, Ltd ... 1450 O'Conner Dr, Toronto 16 ... Can
Hunting Surveys, Inc ... 10 Rockefeller Plaza, New York 20 ... NY
Hunting Surveys, Ltd ... 6 Elstree Way, Boreham Wood, London ... Eng
KELLOGG EXPLORATION CO., Adv Pg 344 ... **3301 N Marengo Ave. Altadena** ... **Cal**
Longyear Co ... 76 S 8th St, Minneapolis 2 ... Minn

CONTRACTORS–*GROUND SOLIDIFICATION & CEMENTATION*

HALLIBURTON CO., Adv Pg 123 ... **Drawer 1431, Duncan** ... **Okla**
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Intrusion-Prepakt Inc ... 568 Union Commerce Bldg, Cleveland 14 ... Ohio
The Rockiron Co, Ltd ... P O Box 1089, Sudbury ... Ont
SPRAGUE & HENWOOD INC., Adv Pg 146 ... **221 W Olive St. Scranton** ... **Pa**

CONTRACTORS–*MAPPING (TOPO)*

Abrams Aerial Survey Corp ... 606 Shawassee St, Lansing ... Mich
Aero Service Corp, (Mid-Continent) ... 1401 S Detroit St, Tulsa ... Okla
Aero Service Corp, (Western) ... 157 W 9th South, Salt Lake City 1 ... Utah
American Air Surveys, Inc ... 907 Penn Ave, Pittsburgh 22 ... Pa
Ammann, Jack, Inc. Engineers & Surveyors ... 931 Broadway, San Antonio ... Tex
Canadian Aero Service Ltd ... 348 Queen St, Ottawa, Ontario ... Can
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Hunting Survey Corp, Ltd ... 1450 O'ConnerDr, Toronto 16 ... Can
Hunting Surveys, Inc ... 10 Rockefeller Plaza, New York 20 ... NY
Hunting Surveys, Ltd ... 6 Elstree Way, Boreham Wood, London ... Eng

CONTRACTORS–*MINE & PROSPECT EXAMINATION & VALUATION–Also See* CONSULTANTS

Carpco Research & Engineering, Inc ... P O Box 3272, Jacksonville 6 ... Fla
Chapman, Wood & Griswold, Ltd ... 525 Vernon Dr, Vancouver 6 ... BC
Geodynamics, Inc ... Box 1258, 1543 3rd St, Santa Monica ... Cal
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Minerals Engineering Co ... P O Box 1951, Grand Junction ... Colo
Singmaster & Breyer Inc ... 420 Lexington Ave, New York 17 ... NY
Southwestern Engineering Co ... 4800 Santa Fe Ave, Los Angeles 58 ... Cal

CONTRACTORS–*MINING–DREDGING*

Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz
Humphreys Engineering Co ... 910 American Natl Bank Bldg, Denver 2 ... Colo

CONTRACTORS–*MINING–OPEN PIT*

BECHTAL CORP., Adv Pg 175 ... **220 Bush St. San Francisco 4** ... **Cal**
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz

CONTRACTORS–*MINING–OPERATIONS RESEARCH*

Geodynamics, Inc ... Box 1258, 1543 3rd St, Santa Monica ... Cal

CONTRACTORS–*MINING–STRIPPING*

BECHTAL CORP., Adv Pg 175 ... **220 Bush St. San Francisco 4** ... **Cal**
Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz

CONTRACTORS–*MINING–UNDERGROUND*

Heinrichs Geoexploration Co ... P O Box 5671, Tucson ... Ariz

CONTROLS–*ELECTRICAL & ELECTRONIC (AUTOMATIC–REMOTE INDICATING–RECORDING–ETC.)–Also See* METERS; COMMUNICATIONS

Allen-Bradley Co ... 136 W Greenfield Ave, Milwaukee 4 ... Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ... **969 S 70 St. Milwaukee 1** ... **Wis**
Automatic Switch Co ... Hanover Rd, Florham Park ... NJ
B-I-F Industries, Inc ... 345 Harris Ave, Providence 1 ... RI
Bailey Meter Co ... 1050 Ivanhoe Rd, Cleveland ... Ohio
Bin-Dicator Co ... 13946-300 Kercheval Ave, Detroit 15 ... Mich
Clark Controller Co ... 1146 E 152 St, Cleveland 10 ... Ohio
Curtiss-Wright Corp ... Box 110, Princeton ... NJ
Cutler-Hammer, Inc ... 237 N 12 St, Milwaukee 1 ... Wis
Daystron, Inc., Weston Instruments Div ... 614 Frelinghuysen Ave, Newark ... NJ
Dietz, Henry G. Co, Inc ... 12-16 Astoria Blvd, Long Island City 2 ... NY
Duraksol, Inc ... 1010 N Main St, Elkhart ... Ind
Engineered Equipment, Inc ... 1001 Linden Ave, Waterloo ... Iowa
Fairbanks, Morse & Co ... 600 S Michigan Ave, Chicago 5 ... Ill
FOXBORO CO., Adv Pg 316 ... **Foxboro** ... **Mass**
Fuller Co, Sub of General American Transportation Corp ... Catasauqua ... Pa
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304 ... **Schenectady 5** ... **NY**
General Railway Signal Co ... Rochester 2 ... NY
Guyan Machinery Co ... 755 Stratton St, Logan ... W Va
HALLIBURTON CO., Adv Pg 123 ... **Drawer 1431, Duncan** ... **Okla**
Hays Corp ... 742 E 8 St, Michigan City ... Ind
Hillman, C. Kirk, Co, Inc ... 3201 First Ave, S, Seattle 4 ... Wash
Industrial Nucleonics Corp ... 650 Ackerman Rd, Columbus 2 ... Ohio
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362 ... **470 S 10 E, Salt Lake City 2** ... **Utah**
Koehring Co ... 3025 W Concordia, Milwaukee 16 ... Wis
Leeds & Northrup Co ... 4970 Stenton Ave, Philadelphia 44 ... Pa
Minneapolis-Honeywell Regulator, Brown Instrument Div ... Wayne & Windrim Ave, Philadelphia 44 ... Pa
Nuclear Chicago Corp ... 333 E Howard St, Des Plaines ... Ill
Ohmart Corp ... Box 67, Cincinnati 22 ... Ohio
Panellit, Inc ... 401 N Hamlin Ave, Skokie ... Ill
Philips Electronic Instruments ... 750 S Fulton Ave, Mt Vernon ... NY
Ramsey Engineering Co ... 1853 W County Rd. C, St Paul ... Minn
Reliance Electric & Engineering ... 24701 Euclid Ave, Cleveland 17 ... Ohio
Research-Cottrell Inc ... Bound Brook ... NJ
Richardson Scale Co ... Clifton ... NJ
Special Instruments Laboratory Inc ... 312 W Vine Ave, Knoxville 2 ... Tenn
Taylor Instrument Cos ... 95 Ames St, Rochester 1 ... NY
Thayer Scale ... Pembroke ... Mass
Toledo Scale Div, Toledo Scale Corp ... 1112 Telegraph Rd, Toledo 12 ... Ohio
Union Switch & Signal Div, Westinghouse Air Brake Co ... Swissvale ... Pa
Vickers Inc, Electric Products Div ... 1815 Locust St, St Louis 3 ... Mo
Webb, Jervis B., Co ... 8951 Alpine Ave, Detroit 4 ... Mich
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151 ... **Box 2278, Pittsburgh 30** ... **Pa**

CONTROLS–*HYDRAULIC & PNEUMATIC (AUTO. REMOTE–ETC.)–Also See* METERS

American Brake Shoe Co ... 530 Fifth Ave, New York 36 ... NY
Automatic Switch Co ... Hanover Rd, Florham Park ... NJ
B-I-F Industries, Inc ... 345 Harris Ave, Providence 1 ... RI
Bailey Meter Co ... 1050 Ivanhoe Rd, Cleveland ... Ohio
Cash, A. W., Co ... Box 551, Decatur ... Ill
Daystron, Inc. Weston Instruments Div ... 614 Frelinghuysen Ave, Newark ... NJ
FOXBORO CO., Adv Pg 316 ... **Foxboro** ... **Mass**
Guyan Machinery Co ... 755 Stratton St, Logan ... W Va
HALLIBURTON CO., Adv Pg 123 ... **Drawer 1431, Duncan** ... **Okla**
Hays Corp ... 742 E 8 St, Michigan City ... Ind
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362 ... **470 S 10 E, Salt Lake City 2** ... **Utah**
Infilco, Inc ... 901 S Campbell Ave, Tucson ... Ariz
Ledeen Mfg Co ... 3350 N Gilman Rd, El Monte ... Cal
Link-Belt Co, Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
OPW-Jordan ... 6013 Wiehe Rd, Cincinnati 13 ... Ohio
Ohmart Corp ... Box 67, Cincinnati 22 ... Ohio
Oilgear Co ... 1560 W Pierce St, Milwaukee 4 ... Wis
Owatonna Tool Co ... 655 Cedar St, Owatonna ... Minn
Parker-Hannifin Corp ... 17325 Euclid Ave, Cleveland 12 ... Ohio
Taylor Instrument Cos ... 95 Ames St, Rochester 1 ... NY
U S Gauge Div, American Machine & Metals ... Sellersville ... Pa
Vickers Inc ... Administrative & Eng Center, Detroit 32 ... Mich
Webb, Jervis B., Co ... 8951 Alpine Ave, Detroit 4 ... Mich
Westinghouse Air Brake Co, Ind Products Div ... P O Box 36, Wilmerding ... Pa

CONVERTERS–*METAL (EQUIPMENT NOT SERVICE)*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ... **969 S 70 St. Milwaukee 1** ... **Wis**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ... **135 S LaSalle St. Chicago 3** ... **Ill**
National Supply Div. Armco Steel Corp ... P O Box 416, Pittsburgh 30 ... Pa
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 ... **Mill St. Allentown** ... **Pa**
TREADWELL, M.H., CO. INC., Adv Pg 75 ... **140 Cedar St. New York 6** ... **NY**

CONVEYOR BELTING

ACME HAMILTON MFG CORP., Adv Pg 166 ... **Meade St. Trenton 3** ... **NJ**
AMERICAN RUBBER CO. BOSTON WOVEN HOSE & RUBBER DIV., Adv Pg 125 ... **Boston 3** ... **Mass**
American Rubber Mfg Co ... 1145 Park Ave, Oakland 8 ... Cal
AMERICAN VISCOSE CORP., Adv Pg 177 ... **1617 Pennsylvania Blvd. Philadelphia 3** ... **Pa**
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
Bonded Scale & Machine Co ... 38 Bellevue Ave, Columbus 7 ... Ohio
Cambridge Wire Cloth Co ... 152 Linkwood Rd, Cambridge ... Md
Cincinnati Rubber Mfg Co Div, Thor Power Tool Co ... Cincinnati 12 ... Ohio
Colorado Fuel & Iron Corp ... 575 Madison Ave, New York 22 ... NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ... **Continental Oil Bldg. Denver 2** ... **Colo**
Daniels, C. R., Inc ... Daniels ... Md
Extremultus, Inc ... 25-11 40 Ave, Long Island City 1 ... NY
Goodall Rubber Co ... Whitehead Rd, Trenton ... NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3 ... **500 S Main St. Akron 18** ... **Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3 ... **500 S Main St. Akron 18** ... **Ohio**
Hewitt-Robins, Inc ... 666 Glenbrook Rd, Stamford ... Conn
Link-Belt Co, Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
Manheim Mfg & Belting Co ... 470 Stiegel St, Manheim ... Pa
Megator Corp ... 930 Manchester Ave, Pittsburgh 12 ... Pa
Mercer Rubber Co ... 136 Mercer St, Trenton 90 ... NJ
NATIONAL MINE SERVICE CO., Adv Pg 144 ... **2530 Koppers Bldg. Pittsburgh 19** ... **Pa**
Northern Conveyor Co, Inc ... Box 46, Janesville ... Wis
H. K. Porter Co, Inc ... Porter Bldg, 601 Grant St, Pittsburgh 19 ... Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 168 ... **601 Grant St. Pittsburgh 19** ... **Pa**
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83 ... **42 Townsend St. Passaic** ... **NJ**
Republic Rubber Div. Lee Rubber & Tire Corp ... Albert St, Youngstown ... Ohio
The Russell Mfg Co ... Middletown ... Conn
Sandvik Steel Inc ... Fair Lawn ... NJ
Sandvik Steel Inc, Steel Belt Conveyor Dept ... 1702 Nevins Rd, Fair Lawn ... NJ
Thermoid Div. H. K. Porter Co, Inc ... Whitehead Rd, Trenton 6 ... NJ
West Virginia Belt Repairs Inc ... Box 32, Mt Hope ... W Va
WESTVIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ... **575 Madison Ave. New York 22** ... **NY**

CONVEYOR BELTING FASTENERS

Armstrong, Bray & Co ... 5364 Northwest Hwy, Chicago 30 ... Ill
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
Bonded Scale & Machine Co ... 38 Bellevue Ave, Columbus 7 ... Ohio
Crescent Fastener Co ... 381 Fourth Ave, New York 16 ... NY
FLEXIBLE STEEL LACING CO., Adv Pg 366 ... **4607 Lexington St. Chicago 44** ... **Ill**
Goodall Rubber Co ... Whitehead Rd, Trenton ... NJ
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3 ... **500 S Main St. Akron 18** ... **Ohio**
Hewitt-Robins, Inc ... 666 Glenbrook Rd, Stamford ... Conn
NATIONAL MINE SERVICE CO., Adv Pg 144 ... **2530 Koppers Bldg. Pittsburgh 19** ... **Pa**
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83 ... **42 Townsend St. Passaic** ... **NJ**
The Russell Mfg Co ... Middletown ... Conn
Thermoid Div. H. K. Porter Co, Inc ... Whitehead Rd, Trenton 6 ... NJ

CONVEYOR BELTING VULCANIZERS

Heintz Mfg Co ... 13110 Enterprise Ave, Cleveland 35 ... Ohio
REMA-TECK, INC., Adv Pg 357 ... **2 Park Ave. New York 16** ... **NY**

CONVEYORS–*BELT–FOR BELTING ALONE–See* CONVEYOR BELTING

BARBER-GREENE CO., Adv. Pgs. 168-169 ... **400 N Highland Ave. Aurora** ... **Ill**
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
Bonded Scale & Machine Co ... 38 Bellevue Ave, Columbus 7 ... Ohio
Columbus Conveyor Co ... 869 W Goodale Blvd, Columbus 12 ... Ohio
Diamond Iron Works Div, Goodman Mfg Co ... Halsted St. & 48 Pl, Chicago 9 ... Ill
Goodman Mfg Co ... Halsted St. & 48th Pl, Chicago 9 ... Ill
Hack Engineering Co ... 124 Wazee Market, Denver ... Colo
Hewitt-Robins, Inc ... 666 Glenbrook Rd, Stamford ... Conn
Iowa Mfg Co ... 916 16 St. NE, Cedar Rapids ... Iowa
Irwin Sensenich Corp ... Box 311, Irwin ... Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... **333 Henry W Oliver Bldg. Pittsburgh 22** ... **Pa**
Link-Belt Co, Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
Long-Airdox Co, Marmon-Herrington Inc ... P O Box 331, Oak Hill ... W Va
Meckun Engineering Inc ... Dayton Rd, Ottawa ... Ill
Northern Conveyor Co, Inc ... Box 46, Janesville ... Wis
H. K. Porter Co, Inc ... Porter Bldg, 601 Grant St, Pittsburgh 19 ... Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 168 ... **601 Grant St. Pittsburgh 19** ... **Pa**
Ridge Equipment Co ... Fallentimber ... Pa
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc ... 201 N Wells St. Chicago 6 ... Ill
Rogers Iron Works Co ... Joplin ... Mo
Sandvik Steel Inc, Steel Belt Conveyor Dept ... 1702 Nevins Rd, Fair Lawn ... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ... **268 Ridgeway Ave. Aurora** ... **Ill**
STURTEVANT MILL CO., Adv Pg 362 ... **101 Clayton St. Boston 22** ... **Mass**
Universal Dredge Mfg Co ... 124 Wazee Market, Denver 4 ... Colo
Universal Road Machinery Co ... Enerick St. Kingston ... NY

CONVEYORS–*BELT–ACCESSORIES (CLEANERS–HOLDBOARDS–ETC.)*

BARBER-GREENE CO., Adv. Pgs. 168-169 ... **400 N Highland Ave. Aurora** ... **Ill**
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
CHAIN BELT CO., Adv Pg 331 ... **4679 W Greenfield Ave. Milwaukee 1** ... **Wis**
Christian, J. D., Engineers ... 480 Potrero Ave, San Francisco 10 ... Cal
Continental Conveyor & Equipment Co ... P O Box 398, Winfield ... Ala
Fairmont Machinery Co ... Fairmont ... W Va
Goodman Mfg Co ... Halsted St. & 48th Pl, Chicago 9 ... Ill
Jeffrey Mfg Co ... 886 N 4th St, Columbus 16 ... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... **333 Henry W Oliver Bldg. Pittsburgh 22** ... **Pa**
LINATEX CORP OF AMERICA, Adv Pg 159 ... **P O Drawer D, Stafford Springs** ... **Conn**
Link-Belt Co, Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
Long-Airdox Co, Marmon-Herrington Inc ... P O Box 331, Oak Hill ... W Va
Megator Corp ... 930 Manchester Ave, Pittsburgh 12 ... Pa
Rogers Iron Works Co ... Joplin ... Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ... **268 Ridgeway Ave. Aurora** ... **Ill**

CONVEYORS–*BELT HOLDBACKS*

BARBER-GREENE CO., Adv. Pgs. 168-169 ... **400 N Highland Ave. Aurora** ... **Ill**
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
Bonded Scale & Machine Co ... 38 Bellevue Ave, Columbus 7 ... Ohio
Christian, J. D., Engineers ... 480 Potrero Ave, San Francisco 10 ... Cal
Continental Conveyor & Equipment Co ... P O Box 398, Winfield ... Ala
Hewitt-Robins, Inc ... 666 Glenbrook Rd, Stamford ... Conn
Iowa Mfg Co ... 916 16 St. NE, Cedar Rapids ... Iowa
Jeffrey Mfg Co ... 886 N 4th St, Columbus 16 ... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... **333 Henry W Oliver Bldg. Pittsburgh 22** ... **Pa**
Link-Belt Co, Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
Marland One-Way Clutch Co ... **Elm Ave. & Washington St. La Grange** ... **Ill**
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ... **307 W Third St. Pittsburg** ... **Kan**
Rogers Iron Works Co ... Joplin ... Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ... **268 Ridgeway Ave. Aurora** ... **Ill**
Webb, Jervis B., Co ... 8951 Alpine Ave, Detroit 4 ... Mich

CONVEYORS–*BELT–IDLERS & PULLEYS*

American Pulley Co ... 4200 Wissanicken Ave, Philadelphia 29 ... Pa
BARBER-GREENE CO., Adv. Pgs. 168-169 ... **400 N Highland Ave. Aurora** ... **Ill**
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
Bonded Scale & Machine Co ... 38 Bellevue Ave, Columbus 7 ... Ohio
CHAIN BELT CO., Adv Pg 331 ... **4679 W Greenfield Ave. Milwaukee 1** ... **Wis**
Christian, J. D., Engineers ... 480 Potrero Ave, San Francisco 10 ... Cal
Columbus Conveyor Co ... 869 W Goodale Blvd, Columbus 12 ... Ohio
Continental Conveyor & Equipment Co ... P O Box 398, Winfield ... Ala
DENVER EQUIPMENT CO., Adv Pg 76 ... **Box 5268, Denver 17** ... **Colo**
Dodge Mfg Corp ... S Union St, Mishawaka ... Ind
Fairmont Machinery Co ... Fairmont ... W Va
Goodman Mfg Co ... Halsted St. & 48th Pl, Chicago 9 ... Ill
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3 ... **500 S Main St. Akron 18** ... **Ohio**
Guyan Machinery Co ... 755 Stratton St, Logan ... W Va
Hewitt-Robins, Inc ... 666 Glenbrook Rd, Stamford ... Conn
Iowa Mfg Co ... 916 16 St. NE, Cedar Rapids ... Iowa
Irwin Sensenich Corp ... Box 311, Irwin ... Pa
Jeffrey Mfg Co ... 886 N 4th St, Columbus 16 ... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... **333 Henry W Oliver Bldg. Pittsburgh 22** ... **Pa**

Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Wagator Corp ..... 930 Manchester Ave. Pittsburgh 12 ..... Pa
New Departure Div. General Motors Corp ..... Bristol ..... Conn
Northern Conveyor Co. Inc ..... Box 46, Janesville ..... Wis
Ogden Iron Works Co ..... 185 23 St. Ogden ..... Utah
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Sandvik Steel Inc ..... Fair Lawn ..... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 614 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich
Western Conveyor Co ..... Box 357, Boise ..... Idah

CONVEYORS–*BELT-TAKE-UPS*

BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
Continental Conveyor & Equipment Co ..... P O Box 398, Winfield ..... Ala
Dodge Mfg Corp ..... S Union St. Mishawaka ..... Ind
Goodman Mfg Co ..... Halsted St. & 48th Pl. Chicago 9 Ill
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ..... **333 Henry W Oliver Bldg. Pittsburgh 22** ..... **Pa**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
Magnetic Engineering & Mfg Co ..... 852 Van Houten Ave. Clifton ..... NJ
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Northern Conveyor Co. Inc ..... Box 46, Janesville ..... Wis
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Rogers Iron Works Co ..... Joplin ..... Mo
Sandvik Steel Inc ..... Fair Lawn ..... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich
Western Conveyor Co ..... Box 357, Boise ..... Idah

CONVEYORS–*BELT-TRIPPERS*

BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
Continental Conveyor & Equipment Co ..... P O Box 398, Winfield ..... Ala
Fairmont Machinery Co ..... Fairmont ..... W Va
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Iowa Mfg Co ..... 916 16 St. NE., Cedar Rapids ..... Iowa
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ..... **333 Henry W Oliver Bldg. Pittsburgh 22** ..... **Pa**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS (& ELEVATORS)–*BUCKET–DOES NOT INCLUDE CONVEYORS: TROLLEY OR DIGGING TYPE See* LOADERS

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... **389 E 14 St. Chicago Heights** ..... **Ill**
B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Continental Conveyor & Equipment Co ..... P O Box 398, Winfield ..... Ala
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Engineered Equipment, Inc ..... 1001 Linden Ave. Waterloo ..... Iowa
Erie Strayer Co ..... Erie ..... Pa
Fairmont Machinery Co ..... Fairmont ..... W Va
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Meckum Engineering Inc ..... Dayton Rd. Ottawa Ill
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Ridge Equipment Co ..... Fallentimber ..... Pa
Rogers Iron Works Co ..... Joplin ..... Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
STURTEVANT MILL CO., Adv Pg 362 ..... **101 Clayton St. Boston 22** ..... **Mass**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Universal Road Machinery Co ..... Emerick St. Kingston ..... NY

CONVEYORS–*CHAIN (DRAG-SCRAPER)-(BULK)–DOES NOT INCLUDE DRAGLINE SCRAPER-SLUSHER; OR DIGGING TYPE See* LOADERS

Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
Columbus McKinnon Corp. Mining Equipment Div ..... 56 Fremont Ave. Tonawanda ..... NY
Fairmont Machinery Co ..... Fairmont ..... W Va
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Northern Conveyor Co. Inc ..... Box 46, Janesville ..... Wis
Ridge Equipment Co ..... Fallentimber ..... Pa
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc ..... 201 N Wells St. Chicago 6 Ill
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Watt Car & Wheel Co ..... Barnesville ..... Ohio
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*CHAIN (PACKAGE)*

Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Foote Bros Gear & Machine Corp, Whitney Chain Co ..... 4545 S Western Blvd. Chicago 9 Ill
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Taylor Wharton Div. Harsco Corp ..... High Bridge ..... NJ
Watt Car & Wheel Co ..... Barnesville ..... Ohio
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*EXTENSIBLE*

BALDWIN-LIMA-HAMILTON CORP. CONSTRUC. TION EQUIPMENT DIV., Adv Pg 126 ..... **5 Main St. Lima** ..... **Ohio**
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Goodman Mfg Co ..... Halsted St. & 48th Pl. Chicago 9 Ill
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ..... **333 Henry W Oliver Bldg. Pittsburgh 22** ..... **Pa**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*LOADING BOOM & STACKER–DOES NOT INCLUDE SMALL DIGGING TYPE See* LOADERS; OR CRANES; OVERHEAD TRAVELING GANTRY; BRIDGE; MONORAIL; ETC.

BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
Diamond Iron Works Div. Goodman Mfg Co ..... Halsted St. & 48 Pl. Chicago 9 Ill
Fairmont Machinery Co ..... Fairmont ..... W Va
The Fairker Corp ..... 7644 Random Rd. Cleveland 6 ..... Ohio
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Iowa Mfg Co ..... 916 16 St. NE., Cedar Rapids ..... Iowa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave. NE, Cleveland 14** ..... **Ohio**
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
TREADWELL, M.H., CO. INC., Adv Pg 78 ..... **140 Cedar St. New York 6** ..... **NY**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*MOBILE (INCLUDING SELF-PROPELLED)–DOES NOT INCLUDE DIGGING TYPE See* LOADERS

Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Goodman Mfg Co ..... Halsted St. & 48th Pl. Chicago 9 Ill
HALLIBURTON CO., Adv Pg 123 ..... **Denver 1431, Duncan** ..... **Okla**
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave. NE, Cleveland 14** ..... **Ohio**
Myers-Whaley Co, Inc ..... Box 789, Knoxville 1 ..... Tenn
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Western Conveyor Co ..... Box 357, Boise ..... Idah

CONVEYORS–*MOVABLE–Also See* CONVEYORS–*MOBILE; DOES NOT INCLUDE DIGGING TYPE See* LOADERS

BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Diamond Iron Works Div. Goodman Mfg Co ..... Halsted St. & 48 Pl. Chicago 9 Ill
ElmCO CORP., Adv Pg 335 ..... **521 W 6th South St. Salt Lake City 10** ..... **Utah**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Goodman Mfg Co ..... Halsted St. & 48th Pl. Chicago 9 Ill
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave. NE, Cleveland 14** ..... **Ohio**
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Robinson Pneumatic Conveyor Systems ..... 80 Fifth Ave. New York 11 ..... NY
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Western Conveyor Co ..... Box 357, Boise ..... Idah
Western Machinery Co, Wemco Div ..... 650 Fifth St. San Francisco 7 ..... Cal

CONVEYORS–*PAN & APRON*

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... **389 E 14 St. Chicago Heights** ..... **Ill**
Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Fairmont Machinery Co ..... Fairmont ..... W Va
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
HAMMERMILLS, INC., Adv Pg 376 ..... **625 C Ave. NW, Cedar Rapids** ..... **Iowa**
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Iowa Mfg Co ..... 916 16 St. NE., Cedar Rapids ..... Iowa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
NATIONAL IRON CO., Adv Pg 333 ..... **Ramsey St. & 50 Ave. W, Duluth 7** ..... **Minn**
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
Roberts & Schaefer Co Div, Thompson-Starrett Co. Inc ..... 201 N Wells St. Chicago 6 Ill
Sorel Steel Foundries Ltd ..... 1405 Peel St. Montreal 2, P.Q. ..... Can
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Taylor Wharton Div. Harsco Corp ..... High Bridge ..... NJ
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 ..... **Mill St. Allentown** ..... **Pa**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich
Western Conveyor Co ..... Box 357, Boise ..... Idah

CONVEYORS–*PNEUMATIC*

Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Conveir, Inc ..... Box 9671, Pittsburgh 26 ..... Pa
Fuller Co. Sub of General American Transportation Corp ..... Catasauqua ..... Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
HALLIBURTON CO., Adv Pg 123 ..... **Denver 1431, Duncan** ..... **Okla**
HALLIBURTON CO., Adv Pg 123 ..... **Denver 1431, Duncan** ..... **Okla**
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave. New York 22** ..... **NY**
Robinson Pneumatic Conveyor Systems ..... 80 Fifth Ave. New York 11 ..... NY
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*ROLLER–GRAVITY & POWERED (PACKAGED)*

Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Magnetic Engineering & Mfg Co ..... 852 Van Houten Ave. Clifton ..... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Taylor Wharton Div. Harsco Corp ..... High Bridge ..... NJ
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich

CONVEYORS–*SCREW OR SPIRAL*

Bitco, Inc ..... Box 2646, Terminal Annex, Spokane 2.. ..... Wash
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
Central Wire Equipment Co ..... 6200 N Broadway, St Louis 15 ..... Mo
Central Wire Equipment Co ..... 6200 N Broadway, St Louis 15 ..... Mo
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Columbus Conveyor Co ..... 869 W Goodale Blvd. Columbus 12 ..... Ohio
Continental Conveyor & Equipment Co ..... P O Box 398, Winfield ..... Ala
Engineered Equipment, Inc ..... 1001 Linden Ave. Waterloo ..... Iowa
Erie Strayer Co ..... Erie ..... Pa
Fairmont Machinery Co ..... Fairmont ..... W Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Long-Airdox Co. Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
STURTEVANT MILL CO., Adv Pg 362 ..... **101 Clayton St. Boston 22** ..... **Mass**
Taylor Wharton Div. Harsco Corp ..... High Bridge ..... NJ
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo

CONVEYORS SECTIONAL PREFAB–*DOES NOT INCLUDE CONVEYORS–MOVABLE*

Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
Diamond Iron Works Div. Goodman Mfg Co ..... Halsted St. & 48 Pl. Chicago 9 Ill
Hewitt-Robins, Inc ..... 666 Glenbrook Rd. Stamford ..... Conn
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg. Fairmont ..... W Va
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Meckum Engineering Inc ..... Dayton Rd. Ottawa Ill
Pioneer Engineering, Div of Poor & Co. Inc ..... 3200 Como Ave. SE., Minneapolis 14 ..... Minn
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Watt Car & Wheel Co ..... Barnesville ..... Ohio
Webb, Jarvis B., Co ..... 8951 Alpine Ave. Detroit 4 ..... Mich
Western Conveyor Co ..... Box 357, Boise ..... Idah

CONVEYORS–*SHAKING & VIBRATING–Also See* FEEDERS

Ajax Flexible Coupling Co, Inc ..... Westfield ..... NY
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Cleveland Vibrator Co ..... 2828 Clinton Ave. Cleveland 13 ..... Ohio
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **Continental Oil Bldg. Denver 2** ..... **Colo**

Davis Foundry & Machine Works	Old Furnace Rd. Rome	Ga
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Fairmont Machinery Co	Fairmont	W Va
Goodman Mfg Co	Halsted St. & 48th Pl. Chicago 9	Ill
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Industrial Engineering & Construction Co	1st Natl Bank Bldg. Fairmont	W Va
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
SIMPLICITY ENGINEERING CO., Adv Pg 349	**Durand**	**Mich**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

CONVEYORS—*TROLLEY—DOES NOT INCLUDE AERIAL CABLEWAYS*

Colorado Fuel & Iron Corp	575 Madison Ave. New York 22	NY
Columbus McKinnon Corp, Mining Equipment Div	56 Fremont Ave, Tonawanda	NY
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Webb, Jervis B., Co	8951 Alpine Ave. Detroit 4	Mich
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

COOLERS- (& CONDENSERS)—*COOLING TOWERS—LIQUID & GAS PROCESS—DOES NOT INCLUDE AIR COMPRESSOR AFTERCOOLERS*

AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
American Standard Industrial Div	Detroit 32	Mich
BETHLEHEM STEEL CO., Adv Pg 48	**Bethlehem**	**Pa**
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Carrier Corp	Carrier Pkwy, Syracuse 1	NY
Fluor Products Co	Box 1267, Santa Rosa	Cal
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

COOLERS—*SOLIDS*

Fuller Co. Sub of General American Transportation Corp	Catasauqua	Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Standard Steel Corp	5060 Boyle Ave. Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28	**Mill St. Allentown**	**Pa**
TREADWELL, W.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

CORE BARRELS—*See* DRILLS

COUPLERS—*MINE CAR—See* CAR COUPLERS

COUPLINGS—*See BELOW; Also See* DRILL ROD; PIPE FITTINGS

COUPLINGS—*MECHANICAL POWER TRANSMISSION—See BELOW; Also See* CLUTCHERS; DRIVES; HUBS)

Ajax Flexible Coupling Co. Inc	Westfield	NY
American Standard Industrial Div	Detroit 32	Mich
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
Diamond Chain Co. Inc	452 Kentucky Ave. Indianapolis 7	Ind
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Foote Bros Gear & Machine Corp. Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Lovejoy Flexible Coupling Co	4932 N Lake St. Chicago 44	Ill
Morse Chain Co. Borg-Warner Industry	Ithaca	NY
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**

COUPLINGS—*M.P.T.—FLEXIBLE*

Ajax Flexible Coupling Co. Inc	Westfield	NY
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
American Standard Industrial Div	Detroit 32	Mich
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Continental-Diamond Fibre Corp. Sub. Budd Co	Newark	Del
Diamond Chain Co. Inc	452 Kentucky Ave. Indianapolis 7	Ind
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
F. A. B. Mfg Co	1249 67 St. Oakland 8	Cal
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Foote Bros Gear & Machine Corp. Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
Garlock Inc	402 E Main St. Palmyra	NY
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Koppers Co. Inc. Metal Prod Div	200 Scott St. Baltimore 30	Md
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Lovejoy Flexible Coupling Co	4932 N Lake St. Chicago 44	Ill
Morse Chain Co. Borg-Warner Industry	Ithaca	NY
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
Thermoid Div. H. K. Porter Co. Inc	Whitehead Rd. Trenton 6	NJ

COUPLINGS—*M.P.T.—RIGID*

Ajax Flexible Coupling Co. Inc	Westfield	NY
Anchor Coupling Co. Inc	342 N Fourth St. Libertyville	Ill
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
Chase Brass & Copper Co	235 Grand St. Waterbury 20	Conn
Dodge Mfg Corp	S Union St. Mishawaka	Ind
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Gustin-Bacon Mfg Co	210 W 10 St. Kansas City	Mo
Koppers Co. Inc. Metal Prod Div	200 Scott St. Baltimore 30	Md
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Morse Chain Co. Borg-Warner Industry	Ithaca	NY
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
Stratoflex Inc	Box 10398, Fort Worth	Tex

CRANES—*NON-REVOLVING JOB & REVOLVING DERRICK—UNMOUNTED (UNDER 10-TON LIFT)*

Austin-Western, Construction Equipment Div. Baldwin-Lima-Hamilton Corp	Aurora	Ill
Baker Industrial Trucks Div. Otis Elevator Co	8094 Baker Ave. NW, Cleveland 2	Ohio
The Forker Corp	2044 Random Rd. Cleveland 6	Ohio
Harrington Co	Gravers Rd. Plymouth Meeting	Pa
Orton Crane & Shovel Co	608 S Dearborn St. Chicago 5	Ill
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
Wright Hoist Div. American Chain & Cable Co, Inc	735 Hay St. York	Pa

CRANES—*NON-REVOLVING JIB-VEHICLE MOUNTED (OVER 10-TON)*

American Hoist & Derrick Co	63 S Robert St. St Paul 7	Minn
Austin-Western, Construction Equipment Div. Baldwin-Lima-Hamilton Corp	Aurora	Ill
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65	**2301 N Adams St. Peoria**	**Ill**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Orton Crane & Shovel Co	608 S Dearborn St. Chicago 5	Ill
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY

CRANES—*OVERHEAD TRAVELING—GANTRY—BRIDGE—MONORAIL—ETC.*

American Hoist & Derrick Co	63 S Robert St. St Paul 7	Minn
Chisholm-Moore Horst Div. Columbus McKinnon Corp	5045 Fremont Ave, Tonawanda	NY
Dravo Corp	Neville Island, Pittsburgh 25	Pa
The Forker Corp	2044 Random Rd. Cleveland 6	Ohio
Garlock Inc	402 E Main St. Palmyra	NY
Hack Engineering Co	124 Wazee Market, Denver	Colo
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Harrington Co	Gravers Rd. Plymouth Meeting	Pa
& Hoist Div	Muskegon	Mich
Lakeside Bridge & Steel Co	5306 N 33 St. Milwaukee 9	Wis
Louden Machinery Co	607 Broadway, Fairfield	Iowa
MANITOWOC ENGINEERING CORP., Adv Pg 29	**S 16 St. Manitowoc**	**Wis**
Manning, Maxwell & Moore Inc. Shaw Box Crane Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
Reading Crane & Hoist Corp	Box 1139, Reading	Pa
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Wright Hoist Div. American Chain & Cable Co, Inc	735 Hay St. York	Pa

CRANES—*REVOLVING DERRICK—CRAWLER—LOCOMOTIVE & WHEELED*

American Hoist & Derrick Co	63 S Robert St. St Paul 7	Minn
Baker Industrial Trucks Div. Otis Elevator Co	8094 Baker Ave. NW, Cleveland 2	Ohio
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**S Main St. Lima**	**Ohio**
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Link-Belt Speeder Corp	1201-6 St. SW, Cedar Rapids	Iowa
MANITOWOC ENGINEERING CORP., Adv Pg 29	**S 16 St. Manitowoc**	**Wis**
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131	**Marion**	**Ohio**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NORTHWEST ENGINEERING CO., Adv Pg 13	**135 S LaSalle St. Chicago 3**	**Ill**
Orton Crane & Shovel Co	608 S Dearborn St. Chicago 5	Ill
Quick-Way Truck Shovel Co	Box 1800, Denver 1	Colo
Schield Bantam Co	221 Park St. Waverly	Iowa
Thew Shovel Co	Lorain	Ohio
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

CRANES—*REVOLVING DERRICK—STATIONARY (OVER 10-TON)*

American Hoist & Derrick Co	63 S Robert St. St Paul 7	Minn
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Manning, Maxwell & Moore Inc. Shaw Box Crane & Hoist Div	Muskegon	Mich
NORTHWEST ENGINEERING CO., Adv Pg 13	**135 S LaSalle St. Chicago 3**	**Ill**
Orton Crane & Shovel Co	608 S Dearborn St. Chicago 5	Ill
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

CRANKSHAFTS—*DIESEL ENGINE*

Baldwin-Lima-Hamilton Corp. Indl Eqpt Div	Philadelphia 42	Pa
Ladish Co	5481 S Packard Ave. Cudahy	Wis

CRUSHER PARTS

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Pulverizer Co	1275 Macklind Ave. St Louis 10	Mo
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**S Main St. Lima**	**Ohio**
Baldwin-Lima-Hamilton Corp. Standard Steel Works Div	Burnham	Pa
Bonded Scale & Machine Co	38 Bellevue Ave. Columbus 7	Ohio
Diamond Iron Works Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
Electric Steel Foundry Co	214 NW 25 Ave. Portland 10	Ore
Frog, Switch & Mfg Co	Carlisle	Pa
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Ladish Co	5481 S Packard Ave. Cudahy	Wis
McLANAHAN CORP., Adv Pg 328	**Hollidaysburg**	**Pa**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310	**Phoenix**	**Ariz**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
Rogers Iron Works Co	Joplin	Mo
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr. Milwaukee 12	Wis
Sorel Steel Foundries Ltd	1405 Peel St. Montreal 2, P.Q.	Can
Stroh Process Steel Co	Calif & Marvista Aves. Pittsburgh 12	Pa
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Thomas Foundries Inc	Box 1111, Birmingham 1	Ala
Tool Steel Gear & Pinion Co	211 Township Ave. Cincinnati 16	Ohio
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

CRUSHERS—*CONE*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Pennsylvania Crusher Div. Bath Iron Works Corp	232 S Matlack St. West Chester	Pa
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr. Milwaukee 12	Wis
STRAUBE MFG CO., Adv Pg 359	**8381 Baldwin St. Oakland 21**	**Cal**
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

CRUSHERS—*DISK*

Bico, Inc	Box 3086, Glenoaks Sta. Burbank	Cal
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**

CRUSHERS—*GYRATORY*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**S Main St. Lima**	**Ohio**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
SIMPLICITY ENGINEERING CO., Adv Pg 349	**Durand**	**Mich**
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr. Milwaukee 12	Wis

CRUSHERS—*HAMMER*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Pulverizer Co	1275 Macklind Ave. St Louis 10	Mo
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**S Main St. Lima**	**Ohio**
Diamond Iron Works Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Pennsylvania Crusher Div. Bath Iron Works Corp	232 S Matlack St. West Chester	Pa
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
Rogers Iron Works Co	Joplin	Mo
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

CRUSHERS—*IMPACT*

GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES		
American Pulverizer Co	1275 Macklind Ave. St Louis 10	Mo
Frog, Switch & Mfg Co	Carlisle	Pa
T. J. Gundlach Machine Co Div of J.M.J. Industries, Inc	#1 Freedom Dr. Belleville	Ill
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
KENNEDY VAN SAUN MFG & ENG CORP Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Lippmann Engineering Works Inc	4603 W Mitchell St. Milwaukee	Wis
McLANAHAN CORP., Adv Pg 328	**Hollidaysburg**	**Pa**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Pennsylvania Crusher Div. Bath Iron Works Corp	232 S Matlack St. West Chester	Pa
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
Rogers Iron Works Co	Joplin	Mo
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

CRUSHERS—*JAW*

Abbe Engineering Co	622C Graybar Bldg. New York 17	NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**S Main St. Lima**	**Ohio**
Bico, Inc	Box 3086, Glenoaks Sta. Burbank	Cal
BIRDSBORO CORP., Adv Pg 136	**Birdsboro**	**Pa**
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Denver Fire Clay Co	3033 Blake St. Denver 17	Colo
Diamond Iron Works Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**

KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ... 405 Park Ave. New York 22 ... NY
McLANAHAN CORP., Adv Pg 338 ... Hollidaysburg ... Pa
MINE & SMELTER SUPPLY CO.,
Adv. Pgs. 322-323 ... Box 9041, Denver 16 ... Colo
Morse Bros Machinery Co ... 2900 Brighton Blvd. Denver ... Colo
Pennsylvania Crusher Div. Bath Iron Works Corp ... 232 S Matlack St. West Chester ... Pa
Pioneer Engineering, Div of Poor & Co, Inc ... 3200 Como Ave. SE, Minneapolis 14 ... Minn
Rogers Iron Works Co ... Joplin ... Mo
Smith Engineering Works, Div of Barber-Greene ... 532 E Capitol Dr. Milwaukee 12 ... Wis
STRAUBE MFG CO., Adv Pg 359 ... 8381 Baldwin St. Oakland 21 ... Cal
Stroh Process Steel Co ... Calif & Wayneta Aves. Pittsburgh 12 ... Pa
STURTEVANT MILL CO., Adv Pg 362 ... 101 Clayton St. Boston 22 ... Mass
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 ... Mill St. Allentown ... Pa
Universal Engineering Corp ... 625 C Ave. NW, Cedar Rapids ... Iowa
Universal Road Machinery Co ... Emerick St. Kingston ... NY

CRUSHERS—*MOBILE UNITS*

American Pulverizer Co ... 1275 Macklind Ave. St Louis 10 ... Mo
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 126 ... 5 Main St. Lima ... Ohio
Bonded Scale & Machine Co ... 38 Belleveue Ave. Columbus 7 ... Ohio
DENVER EQUIPMENT CO., Adv Pg 76 ... Box 5268, Denver 17 ... Colo
Diamond Iron Works Div. Goodman Mfg Co ... Halsted St. & 48 Pl. Chicago 9 ... Ill
HAMMERMILLS, INC., Adv Pg 376 ... 625 C Ave. NW, Cedar Rapids ... Iowa
Iowa Mfg Co ... 916 16 St. NE, Cedar Rapids ... Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ... 405 Park Ave. New York 22 ... NY
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ... 3073 S Chase Ave. Milwaukee 1 ... Wis
Pioneer Engineering, Div of Poor & Co, Inc ... 3200 Como Ave. SE, Minneapolis 14 ... Minn
Rogers Iron Works Co ... Joplin ... Mo
Smith Engineering Works, Div of Barber-Greene ... 532 E Capitol Dr. Milwaukee 12 ... Wis
STURTEVANT MILL CO., Adv Pg 362 ... 101 Clayton St. Boston 22 ... Mass
Universal Engineering Corp ... 625 C Ave. NW, Cedar Rapids ... Iowa
Universal Road Machinery Co ... Emerick St. Kingston ... NY

CRUSHERS—*RING ROLL*

Abbe Engineering Co ... 622C Graybar Bldg. New York 17 ... NY
American Pulverizer Co ... 1275 Macklind Ave. St Louis 10 ... Mo
HAMMERMILLS, INC., Adv Pg 376 ... 625 C Ave. NW, Cedar Rapids ... Iowa
Pennsylvania Crusher Div. Bath Iron Works Corp ... 232 S Matlack St. West Chester ... Pa
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ... 260 Ridgeway Ave. Aurora ... Ill
STURTEVANT MILL CO., Adv Pg 362 ... 101 Clayton St. Boston 22 ... Mass

CRUSHERS—*ROLL*

Abbe Engineering Co ... 622C Graybar Bldg. New York 17 ... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ... 969 S 70 St. Milwaukee 1 ... Wis
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 126 ... 5 Main St. Lima ... Ohio
Bonded Scale & Machine Co ... 38 Belleveue Ave. Columbus 7 ... Ohio
DENVER EQUIPMENT CO., Adv Pg 76 ... Box 5268, Denver 17 ... Colo
Diamond Iron Works Div. Goodman Mfg Co ... Halsted St. & 48 Pl. Chicago 9 ... Ill
Exolon Co ... E Niagara St. Tonawanda ... NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ... 135 S LaSalle St. Chicago 3 ... Ill
T. J. Gundlach Machine Co Div of J.M.J. Industries, Inc ... #1 Freedom Dr. Belleville ... Ill
HAMMERMILLS, INC., Adv Pg 376 ... 625 C Ave. NW, Cedar Rapids ... Iowa
Hewitt-Robens, Inc ... 666 Glenbrook Rd. Stamford ... Conn
Iowa Mfg Co ... 916 16 St. NE, Cedar Rapids ... Iowa
Jeffrey Mfg Co ... 896 N 4th St. Columbus 16 ... Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ... 405 Park Ave. New York 22 ... NY
Link-Belt Co. Dept. EMJ-61 ... Prudential Plaza, Chicago 1 ... Ill
McLANAHAN CORP., Adv Pg 338 ... Hollidaysburg ... Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 132 ... 307 W Third St. Pittsburg ... Kan
Morse Bros Machinery Co ... 2900 Brighton Blvd. Denver ... Colo
Pennsylvania Crusher Div. Bath Iron Works Corp ... 232 S Matlack St. West Chester ... Pa
Pioneer Engineering, Div of Poor & Co, Inc ... 3200 Como Ave. SE, Minneapolis 14 ... Minn
Ridge Equipment Co ... Fallentimber ... Pa
Rogers Iron Works Co ... Joplin ... Mo
Smith Engineering Works, Div of Barber-Greene ... 532 E Capitol Dr. Milwaukee 12 ... Wis
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ... 260 Ridgeway Ave. Aurora ... Ill
STURTEVANT MILL CO., Adv Pg 362 ... 101 Clayton St. Boston 22 ... Mass
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 ... Mill St. Allentown ... Pa
Universal Engineering Corp ... 625 C Ave. NW, Cedar Rapids ... Iowa

CUTTING MACHINE BITS (ROCK)

Allegheny Ludlum Steel Corp ... Oliver Bldg. Pittsburgh 22 ... Pa
Central Mine Equipment Co ... 6200 N Broadway, St Louis 15 ... Mo
Firth Sterling, Inc ... 3113 Forbes Ave, Pittsburgh 30 ... Pa
Kennametal Inc. Mining Tool Div ... Bedford ... Pa
Koehring Co ... 3026 W Concordia, Milwaukee 16 ... Wis
Metallurgical Products Dept. General Electric Co ... 11177 E 8 Mile Rd, Detroit 32 ... Mich
Midwestern Engine & Equipment Co ... Box 1866, Tulsa ... Okla
NATIONAL MINE SERVICE CO., Adv Pg 144 ... 2530 Koppers Bldg. Pittsburgh 19 ... Pa
VASCOLOY-RAMET CORP., Adv Pg 134 ... 600 Market St. Washington ... Ill

CUTTING MACHINE PARTS (ROCK)

JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Penn Machine Co ... 905 H. K. Porter Bldg. Pittsburgh 19 ... Pa
Penn Machine Co ... 106 Station St. Johnstown ... Pa
Penn Machine Co ... P O Box 24, Huntington ... W Va

CUTTING MACHINES (ROCK) *DOES NOT INCLUDE CONTINUOUS MINERS & PLANNERS*

JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Kersey Mfg Co, Inc ... Box 151, Glenfield ... Va
TREADWELL, N.R., CO. INC., Adv Pg 75 ... 140 Cedar St. New York 6 ... NY

CYANIDE—*See CHEMICALS*

CYANIDING PROCESS EQUIPMENT *(SPECIAL)—DOES NOT INCLUDE STANDARD AUXILIARY EQUIPMENT*

Morse Bros Machinery Co ... 2900 Brighton Blvd. Denver ... Colo

CYCLONES—*See CLASSIFIERS*

CYLINDERS—*AIR & HYDRAULIC*

American Cast Iron Pipe Co ... 2930 16th St. N, Birmingham 2 ... Ala
Bailey Meter Co ... 1050 Ivanhoe Rd, Cleveland ... Ohio
Benton Harbor Engineering Works, Inc ... 622 Langley Ave. St Joseph ... Mich
BETHLEHEM STEEL CO., Adv Pg 46 ... Bethlehem ... Pa
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
CARD, C. S., IRON WORKS, Adv Pg 356 ... 2501 W 16th Ave. Denver 4 ... Colo
Commercial Shearing & Stamping Co ... Dept. EMJ-MG, 1775 Logan Ave. Youngstown ... Ohio
Galland Henning Mfg Co. Hopak Div ... 2753 S 31 St. Milwaukee 46 ... Wis
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ... 135 S LaSalle St. Chicago 3 ... Ill
Ledeen Mfg Co ... 3350 N Gilman Rd. El Monte ... Cal
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 360 ... 113 St Clair Ave. NE, Cleveland 14 ... Ohio
Oilgear Co ... 1560 W Pierce St. Milwaukee 4 ... Wis
Owatonna Tool Co ... 655 Cedar St. Owatonna ... Minn
Parker-Hannifin Corp ... 17325 Euclid Ave. Cleveland 12 ... Ohio
Scott Aviation Corp ... Lancaster ... NY
Star Hydraulics Inc ... 2638 Davisson St. River Grove ... Ill
Vickers Inc ... Administrative & Eng Center, Detroit 32 ... Mich
Westinghouse Air Brake Co, Ind Products Div ... P O Box 36, Wilmerding ... Pa

DIAMONDS—*INDUSTRIAL*

BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... 1275-1291 Parker St. Vancouver 6 ... Can
DIAMOND TOOL RESEARCH CO. INC., Adv Pg 363 ... 380 Second Ave. New York 10 ... NY
Engelhard Industries, Inc ... 113 Astor St. Newark ... NJ
Metal Carbides Corp ... 6001 Southern Blvd. Youngstown 12 ... Ohio
Metallurgical Products Dept. General Electric Co ... 11177 E 8 Mile Rd. Detroit 32 ... Mich
SMIT, ANTON & CO., Adv Pg 351 ... 111 Eighth Ave. New York 11 ... NY
SMIT, J. K., & SONS INC., Adv Pg 353 ... Harrey Hill ... NJ
SPRAGUE & HENWOOD INC., Adv Pg 146 ... 221 W Olive St. Scranton ... Pa
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover ... 3200 W Davison Ave. Detroit 38 ... Mich

DOORS—*MINE—See MINE DOORS*

DRAFTING EQUIPMENT & SUPPLIES *Also See BLUE PRINT & WHITE PRINT MACHINES*

Draftette Corp ... P O Box 794, Beverly Hills ... Cal
Geophysical Instrument & Supply ... 1616 Broadway, Denver 2 ... Colo
Kern Instruments, Inc ... P O Box 727, White Plains ... NY
Frederick Post Co ... 3650 N Avondale Ave. Chicago 18 ... Ill
Warren-Knight Co ... 136 N 12 St. Philadelphia 7 ... Pa

DRAGLINES—*See EXCAVATORS*

DREDGES—*BUCKETLINE*

Dominion Engineering Co. Ltd ... Box 220, Montreal, Quebec ... Can
ELLICOTT MACHINE CORP., Adv Pg 348 ... 1633 Bush St. Baltimore 30 ... Md
Taylor Wharton Div., Harsco Corp ... High Bridge ... NJ
Washington Iron Works ... 1500 6 Ave. S, Seattle 4 ... Wash

DREDGES—*DIPPER SHOVEL*

Dominion Engineering Co. Ltd ... Box 220, Montreal, Quebec ... Can
ELLICOTT MACHINE CORP., Adv Pg 348 ... 1633 Bush St. Baltimore 30 ... Md
MANITOWOC ENGINEERING CORP., Adv Pg 29 ... 5 16 St. Manitowoc ... Wis
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131 ... Marion ... Ohio

DREDGES—*DRAGLINE & GRAB CRANE*

Dominion Engineering Co. Ltd ... Box 220, Montreal, Quebec ... Can
ELLICOTT MACHINE CORP., Adv Pg 348 ... 1633 Bush St. Baltimore 30 ... Md
MANITOWOC ENGINEERING CORP., Adv Pg 29 ... 5 16 St. Manitowoc ... Wis
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131 ... Marion ... Ohio

DREDGES—*SUCTION*

Acrow Corp of America ... 231 Washington Ave. Carlstadt ... NJ
Cargco Research & Engineering, Inc ... P O Box 3272, Jacksonville 6 ... Fla
Eagle Iron Works ... 262 Holcomb Ave. Des Moines 4 ... Iowa
ELLICOTT MACHINE CORP., Adv Pg 348 ... 1633 Bush St. Baltimore 30 ... Md
Hack Engineering Co ... 124 Wazee Market, Denver ... Colo
HUGHES TOOL CO., Adv. Pgs. 126-127 ... 5425 Polk St. Houston ... Tex
Meckum Engineering Inc ... Dayton Rd. Ottawa ... Ill
Morris Machine Works ... Baldwinsville ... NY
Pacific Coast Engineering Co ... Oak & Clement Sts. Alameda ... Cal
Universal Dredge Mfg Co ... 124 Wazee Market, Denver 4 ... Colo

DREDGE HULLS—*Also See BARGES*

BETHLEHEM STEEL CO., Adv Pg 46 ... Bethlehem ... Pa
ELLICOTT MACHINE CORP., Adv Pg 348 ... 1633 Bush St. Baltimore 30 ... Md
MANITOWOC ENGINEERING CORP., Adv Pg 29 ... 5 16 St. Manitowoc ... Wis
Meckum Engineering Inc ... Dayton Rd. Ottawa ... Ill
Morris Machine Works ... Baldwinsville ... NY
Pacific Coast Engineering Co ... Oak & Clement Sts. Alameda ... Cal

DREDGE SLEEVES

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 ... 389 E 14 St. Chicago Heights ... Ill
American Rubber Mfg Co ... 1145 Park Ave. Oakland 8 ... Cal
Goodall Rubber Co ... Whitehead Rd. Trenton ... NJ
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3 ... 500 S Main St. Akron 18 ... Ohio
Meckum Engineering Inc ... Dayton Rd. Ottawa ... Ill
Morris Machine Works ... Baldwinsville ... NY
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83 ... 42 Townsend St. Passaic ... NJ
Sorel Steel Foundries Ltd ... 1405 Peel St. Montreal 2, P.Q. ... Can

DRILL (ROCK) BITS—*AUGER*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
Central Mine Equipment Co ... 6200 N Broadway, St Louis 15 ... Mo
Central Mine Equipment Co ... 6200 N Broadway, St Louis 15 ... Mo
Firth Sterling, Inc ... 3113 Forbes Ave, Pittsburgh 30 ... Pa
GARDNER DENVER CO., Adv. Pgs. 142-143 ... Gardner Expwy. Quincy ... Ill
Hawthorne, Inc ... Box 7366, Houston 8 ... Tex
Kennametal Inc. Mining Tool Div ... Bedford ... Pa
Koehring Co ... 3026 W Concordia, Milwaukee 16 ... Wis
Long-Airdox Co. Marmon-Herrington Inc ... P O Box 331, Oak Hill ... W Va
Mayhew Machine & Supply Co ... Box 7726, Dallas ... Tex
Metallurgical Products Dept. General Electric Co ... 11177 E 8 Mile Rd. Detroit 32 ... Mich
Midwestern Engine & Equipment Co ... Box 1866, Tulsa ... Okla
Mobile Drilling Inc ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
NATIONAL MINE SERVICE CO., Adv Pg 144 ... 2530 Koppers Bldg. Pittsburgh 19 ... Pa
Salem Tool Co ... Salem ... Ohio
Thor Power Tool Co ... 175 N State St. Aurora ... Ill
VASCOLOY-RAMET CORP., Adv Pg 134 ... 600 Market St. Washington ... Ill

DRILL (ROCK) BITS (& STEMS)—*CHURN*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
GARDNER DENVER CO., Adv. Pgs. 142-143 ... Gardner Expwy. Quincy ... Ill
Kaydon Engineering Corp ... Muskegon ... Mich
Koehring Co ... 3026 W Concordia, Milwaukee 16 ... Wis
Mayhew Machine & Supply Co ... Box 7726, Dallas ... Tex
MOBILE DRILLING INC., Adv Pg 325 ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
SPANG & CO., Adv Pg 330 ... 143 Etna St. Butler ... Pa

DRILL (ROCK) BITS—*CORE*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... 1275-1291 Parker St. Vancouver 6 ... Can
Diamond Drill Contracting Co ... 1015 N Yardly Rd, Box 136, Spokane ... Wash
GARDNER DENVER CO., Adv. Pgs. 142-143 ... Gardner Expwy. Quincy ... Ill
Havlick, J. L. ... 112 S Cedar St. Spokane ... Wash
HOFFMAN BROS. DRILLING CO., Adv Pg 346 ... Tiona St. Ext. Pleasantown ... Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Kennametal Inc. Mining Tool Div ... Bedford ... Pa
Longyear Co ... 76 S 8th St. Minneapolis 2 ... Minn
Mayhew Machine & Supply Co ... Box 7726, Dallas ... Tex
McClintock Co ... W 418 Second Ave. Spokane ... Wash
MOBILE DRILLING INC., Adv Pg 325 ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
Reed Roller Bit Co ... P O Box 2119, Houston 1 ... Tex
SPRAGUE & HENWOOD INC., Adv Pg 146 ... 221 W Olive St. Scranton ... Pa

DRILL (ROCK) BITS—*DIAMOND*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... 1275-1291 Parker St. Vancouver 6 ... Can
CHRISTENSEN DIAMOND PRODUCTS CO., Adv. Pgs. 120-121 ... P O Box 387, Salt Lake City 10 ... Utah
Diamond Drill Contracting Co ... 1015 N Yardly Rd, Box 136, Spokane ... Wash
Diamond Products Inc ... 333 Prospect St. Elyria ... Ohio
DIAMOND TOOL RESEARCH CO. INC., Adv Pg 363 ... 380 Second Ave. New York 10 ... NY
Failing, George E., Co ... Enid ... Okla
Havlick, J. L. ... 112 S Cedar St. Spokane ... Wash
HOFFMAN BROS. DRILLING CO., Adv Pg 346 ... Tiona St. Ext. Pleasantown ... Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Koehring Co ... 3026 W Concordia, Milwaukee 16 ... Wis
Longyear Co ... 76 S 8th St. Minneapolis 2 ... Minn
Mayhew Machine & Supply Co ... Box 7726, Dallas ... Tex
McClintock Co ... W 418 Second Ave. Spokane ... Wash
Metal Carbides Corp ... 6001 Southern Blvd. Youngstown 12 ... Ohio
MOBILE DRILLING INC., Adv Pg 325 ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
SMIT, ANTON & CO., Adv Pg 351 ... 111 Eighth Ave. New York 11 ... NY
SMIT, J. K., & SONS INC., Adv Pg 353 ... Harrey Hill ... NJ
SPRAGUE & HENWOOD INC., Adv Pg 146 ... 221 W Olive St. Scranton ... Pa
Varel Mfg Co ... 9230 Denton Dr. Dallas 20 ... Tex
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover ... 3200 W Davison Ave. Detroit 38 ... Mich

DRILL (ROCK) BITS—*DIAMOND—RESETTING SERVICE*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... 1275-1291 Parker St. Vancouver 6 ... Can
CHRISTENSEN DIAMOND PRODUCTS CO., Adv. Pgs. 120-121 ... P O Box 387, Salt Lake City 10 ... Utah
Diamond Drill Contracting Co ... 1015 N Yardly Rd, Box 136, Spokane ... Wash
Diamond Products Inc ... Elyria ... Ohio
DIAMOND TOOL RESEARCH CO. INC., Adv Pg 363 ... 380 Second Ave. New York 10 ... NY
Havlick, J. L. ... 112 S Cedar St. Spokane ... Wash
HOFFMAN BROS. DRILLING CO., Adv Pg 346 ... Tiona St. Ext. Pleasantown ... Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Longyear Co ... 76 S 8th St. Minneapolis 2 ... Minn
McClintock Co ... W 418 Second Ave. Spokane ... Wash
Metal Carbides Corp ... 6001 Southern Blvd. Youngstown 12 ... Ohio
MOBILE DRILLING INC., Adv Pg 325 ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
SMIT, ANTON & CO., Adv Pg 351 ... 111 Eighth Ave. New York 11 ... NY
SMIT, J. K., & SONS INC., Adv Pg 353 ... Harrey Hill ... NJ
SPRAGUE & HENWOOD INC., Adv Pg 146 ... 221 W Olive St. Scranton ... Pa
Varel Mfg Co ... 9230 Denton Dr. Dallas 20 ... Tex
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover ... 3200 W Davison Ave. Detroit 38 ... Mich

DRILL (ROCK) BITS—*PERCUSSION*

ATLAS COPCO, INC., Adv. Pgs. 54-55 ... 565 Fifth Ave. New York 17 ... NY
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
BRINGHER & LAY, INC., Adv Pg 354 ... 1300 W King St. Franklin Park ... Ill
Brunner & Lay-Eastern, Inc ... 2514-16 E Cumberland St. Phila 25 ... Pa
GARDNER DENVER CO., Adv. Pgs. 142-143 ... Gardner Expwy. Quincy ... Ill
Homelite, Div of Textron Inc ... 75 Riverdale Ave. Port Chester ... NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 ... 11 Broadway, New York 4 ... NY
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ... Pa
Koehring Co ... 3026 W Concordia, Milwaukee 16 ... Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301 ... Sidney ... Ohio
Midwestern Engine & Equipment Co ... Box 1866, Tulsa ... Okla
Mission Mfg Co ... Box 4209, Houston ... Tex
MOBILE DRILLING INC., Adv Pg 325 ... 960 N Pennsylvania St. Indianapolis 4 ... Ind
Schramm Inc ... 870 E Virginia Ave. West Chester ... Pa
SECURITY ENGINEERING DIV., Adv Pg 140 ... P O Box 13667, Dallas 11 ... Tex
SPANG & CO., Adv Pg 330 ... 143 Etna St. Butler ... Pa
Thompson Products Ltd ... St Catherines, Ontario ... Can
THE TIMKEN ROLLER BEARING CO., Adv. Pgs. 289, 4th Cover ... 1835 Dueber Ave. Canton ... Ohio
VASCOLOY-RAMET CORP., Adv Pg 134 ... 600 Market St. Washington ... Ill
WESTERN ROCK BIT MFG CO., Adv Pg 295 ... 552 W 7th S, Salt Lake City 1 ... Utah

DRILL (ROCK) BITS—*ROTARY—ROLLER CONE*

ACKER DRILL CO. INC., Adv Pg 360 ... Box 830, Scranton ... Pa
Bitco, Inc ... Box 2646, Terminal Annex, Spokane 2 ... Wash
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 ... 1275-1291 Parker St. Vancouver 6 ... Can
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 ... 6 E 44th St. New York 17 ... NY

CHRISTENSEN DIAMOND PRODUCTS CO.,
Adv. Pgs. 120-121 — **P O Box 387, Salt Lake City 10** — **Utah**
Failing, George E., Co — Enid — Okla
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
HUGHES TOOL CO., Adv. Pgs. 126-127 — **5425 Polk St. Houston** — **Tex**
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Reed Roller Bit Co — P O Box 2119, Houston 1 — Tex
SECURITY ENGINEERING DIV., Adv Pg 140 — **P O Box 13647, Dallas 11** — **Tex**
Smith Tool Co — Box 431, Compton — Cal
Varel Mfg Co — 9230 Denton Dr. Dallas 20 — Tex

DRILL (ROCK) BITS—*ROTARY DRAG—LARGE HOLE (+4 IN.) QUARRY & WELL (SPADE—PRONG—ETC.)*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
Central Mine Equipment Co — 6200 N Broadway, St Louis 15 — Mo
Failing, George E., Co — Enid — Okla
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Hawthorne, Inc — Box 7366, Houston 8 — Tex
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Kennametal Inc. Mining Tool Div — Bedford — Pa
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Varel Mfg Co — 9230 Denton Dr. Dallas 20 — Tex
VASCOLOY-RAMET CORP., Adv Pg 134 — **800 Market St. Waukegan** — **Ill**
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) BITS—*ROTARY-DRAG-SMALL HOLE (-4 IN.) (SPADE-PRONG-ETC.)*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
Allegheny Ludlum Steel Corp — Oliver Bldg. Pittsburgh 22 — Pa
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
Central Mine Equipment Co — 6200 N Broadway, St Louis 15 — Mo
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
Failing, George E., Co — Enid — Okla
Fletcher, J. H. & Co — 707 W 7th St. Huntington — W Va
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Hawthorne, Inc — Box 7366, Houston 8 — Tex
Kennametal Inc. Mining Tool Div — Bedford — Pa
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Varel Mfg Co — 9230 Denton Dr. Dallas 20 — Tex
VASCOLOY-RAMET CORP., Adv Pg 134 — **800 Market St. Waukegan** — **Ill**

DRILL (ROCK) BIT & STEEL FORGING & HEAT TREATING FURNACES
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
Central Mine Equipment Co — 6200 N Broadway, St Louis 15 — Mo
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**

DRILL (ROCK) BIT & STEEL FORGINGS HAMMERS
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**

DRILL (ROCK) BIT & STEEL GRINDERS
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
Black & Decker Mfg Co — 600 E Pennsylvania Ave. Towson — Md
BLOUNT, J. G., Adv Pg 355 — **Everett** — **Mass**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex

DRILL (ROCK) BOOMS—*EXTENSIBLE & MOBILE*—*Also See* **BOOMS & TOWERS: DRILL (ROCK) JUMBOS**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
MACHINERY CENTER INC., Adv Pg 355 — **Box 964, 1201 S 6 St. Salt Lake City 10** — **Utah**
Rogers Iron Works Co — Joplin — Mo
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) CORE BARRELS
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 — **1275-1291 Parker St. Vancouver 6** — **Can**
CHRISTENSEN DIAMOND PRODUCTS CO.,
Adv. Pgs. 120-121 — **P O Box 387, Salt Lake City 10** — **Utah**
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
HOFFMAN BROS. DRILLING CO., Adv Pg 346 — **Tiona St. Ext. Punxsutawney** — **Pa**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Longyear Co — 76 S 8th St. Minneapolis 2 — Minn
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
McClintock Co — W 418 Second Ave. Spokane — Wash
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Reed Roller Bit Co — P O Box 2119, Houston 1 — Tex
SPRAGUE & HENWOOD INC., Adv Pg 146 — **221 W Olive St. Scranton** — **Pa**
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**

DRILL (ROCK) DUST COLLECTORS (SMALL HOLE DRILLS)
DUCON CO. INC., Adv Pg 158 — **153 E Second St. Mineola** — **NY**
Fletcher, J. H. & Co — 707 W 7th St. Huntington — W Va
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Homelite, Div of Textron Inc — 75 Riverdale Ave. Port Chester — NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
Markley Dust Control System Inc — 80 Snyder Rd. Ramsey — NJ
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
MINE SAFETY APPLIANCES CO., Adv Pg 117 — **201 N Braddock Ave. Pittsburgh 8** — **Pa**
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) DUST COLLECTORS (QUARRY DRILLS)
DUCON CO. INC., Adv Pg 158 — **153 E Second St. Mineola** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
Markley Dust Control System Inc — 80 Snyder Rd. Ramsey — NJ
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) JUMBOS & WAGONS—*Also See* **BOOMS & TOWERS: DRILL (ROCK) BOOMS**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
MACHINERY CENTER INC., Adv Pg 355 — **Box 964, 1201 S 6 St. Salt Lake City 10** — **Utah**
Rogers Iron Works Co — Joplin — Mo
Thor Power Tool Co — 175 N State St. Aurora — Ill
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo
Alimak Corp — 913 Airport Blvd. South San Francisco — Cal

DRILL (ROCK) RODS—*DIAMOND*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 — **1275-1291 Parker St. Vancouver 6** — **Can**
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
HOFFMAN BROS. DRILLING CO., Adv Pg 346 — **Tiona St. Ext. Punxsutawney** — **Pa**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Longyear Co — 76 S 8th St. Minneapolis 2 — Minn
McClintock Co — W 418 Second Ave. Spokane — Wash
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
SPRAGUE & HENWOOD INC., Adv Pg 146 — **221 W Olive St. Scranton** — **Pa**
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**

DRILL (ROCK) RODS—*PERCUSSION*
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
BRUNNER & LAY, INC., Adv Pg 354 — **9300 W King St. Franklin Park** — **Ill**
Brunner & Lay-Eastern, Inc — 2514-16 E Cumberland St. Phila 25 — Pa
Coeur D'Alenes Co — Wallace — Idaho
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Homelite, Div of Textron Inc — 75 Riverdale Ave. Port Chester — NY
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Thompson Products Ltd — St Catherines, Ontario — Can

DRILL (ROCK) RODS—*ROTARY LARGE HOLE (QUARRY & WELL)*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
Failing, George E., Co — Enid — Okla
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Reed Roller Bit Co — P O Box 2119, Houston 1 — Tex
Varel Mfg Co — 9230 Denton Dr. Dallas 20 — Tex
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) RODS—*ROTARY SMALL HOLE*
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
Fletcher, J. H. & Co — 707 W 7th St. Huntington — W Va
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILL (ROCK) ROD COUPLINGS
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2... — Wash
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 — **1275-1291 Parker St. Vancouver 6** — **Can**
BRUNNER & LAY, INC., Adv Pg 354 — **9300 W King St. Franklin Park** — **Ill**
Brunner & Lay-Eastern, Inc — 2514-16 E Cumberland St. Phila 25 — Pa
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
HOFFMAN BROS. DRILLING CO., Adv Pg 346 — **Tiona St. Ext. Punxsutawney** — **Pa**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Reed Roller Bit Co — P O Box 2119, Houston 1 — Tex
SPRAGUE & HENWOOD INC., Adv Pg 146 — **221 W Olive St. Scranton** — **Pa**
Thompson Products Ltd — St Catherines, Ontario — Can

DRILL STEEL—*See* **DRILL (ROCK) RODS**

DRILL (ROCK) SUPPORTS (*COLUMNS—BARS—ETC.*)—*Also See* **DRILL (ROCK) JUMBOS: DRILL (ROCK) BOOMS**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
MACHINERY CENTER, INC., Adv Pg 355 — **1201 S 6th West, Salt Lake City 10** — **Utah**

DRILLS (ROCK & EARTH)—*AUGER (SURFACE RIG)*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
Central Mine Equipment Co — 6200 N Broadway, St Louis 15 — Mo
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Long-Airdox Co. Marmon-Herrington Inc — P O Box 331, Oak Hill — W Va
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Salem Tool Co — Salem — Ohio
Thor Power Tool Co — 175 N State St. Aurora — Ill

DRILLS—*BORERS & CORERS SPECIAL LARGE DIAMETER RIGS (+12 in.)*—*Also See* **CONTINUOUS MINERS:** *DOES NOT INCLUDE CUTTING MACHINES OR OTHER DRILLS LISTED ABOVE*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Salem Tool Co — Salem — Ohio

DRILLS (ROCK)—*CHURN*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
BUCYRUS-ERIE CO., Adv. Pgs., 72, 312 — **South Milwaukee** — **Wis**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Hossfeld Manufacturing Co — Box 478, Winona — Minn
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis

DRILLS (ROCK) COMPRESSED AIR POWERED
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave. New York 17** — **NY**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 — **South Milwaukee** — **Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
Failing, George E., Co — Enid — Okla
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
Packsack Diamond Drills Ltd — 1385 Hammond St. North Bay, Ontario — Can
Schramm Inc — 870 E Virginia Ave. West Chester — Pa
Thor Power Tool Co — 175 N State St. Aurora — Ill
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**

DRILLS (ROCK)—*DIAMOND*
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
BOYLES BROS DRILLING CO. LTD., Adv Pg 133 — **1275-1291 Parker St. Vancouver 6** — **Can**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
McClintock Co — W 418 Second Ave. Spokane — Wash
Metal Carbides Corp — 6001 Southern Blvd. Youngstown 12 — Ohio
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Packsack Diamond Drills Ltd — 1385 Hammond St. North Bay, Ontario — Can
SMIT, J. K., & SONS INC., Adv Pg 333 — **Murray Hill** — **NJ**
SPRAGUE & HENWOOD INC., Adv Pg 146 — **221 W Olive St. Scranton** — **Pa**
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**

DRILLS (ROCK) ELECTRIC POWERED
ACKER DRILL CO. INC., Adv Pg 360 — **Box 830, Scranton** — **Pa**
Black & Decker Mfg Co — 600 E Pennsylvania Ave. Towson — Md
Diamond Drill Contracting Co — 1015 N Yardly Rd. Box 136, Spokane... — Wash
Homelite, Div of Textron Inc — 75 Riverdale Ave. Port Chester — NY
Jeffrey Mfg Co — 886 N 4th St. Columbus 16 — Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Salem Tool Co — Salem — Ohio
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**

DRILLS (ROCK)—*FLAME-JET PIERCING*
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 — **South Milwaukee** — **Wis**
Linde Co. Union Carbide Corp — 270 Park Ave. New York 17 — NY

DRILLS (ROCK) INTERNAL COMBUSTION ENGINE POWERED
Hossfeld Manufacturing Co — Box 478, Winona — Minn
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
Long-Airdox Co. Marmon-Herrington Inc — P O Box 331, Oak Hill — W Va
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
McCulloch Corp. Los Angeles Div — 6101 W Century Blvd. Los Angeles 45 — Cal
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Packsack Diamond Drills Ltd — 1385 Hammond St. North Bay, Ontario — Can
Salem Tool Co — Salem — Ohio
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover — **3200 W Davison Ave. Detroit 38** — **Mich**
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILLS (ROCK)—*PERCUSSION-LARGE HOLE (+4 IN.)-QUARRY & WELL*
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 — **South Milwaukee** — **Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
Failing, George E., Co — Enid — Okla
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
Hillman, C. Kirk, Co. Inc — 3201 First Ave. S, Seattle 4 — Wash
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
Mayhew Machine & Supply Co — Box 7726, Dallas — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**

DRILLS (ROCK)—*PERCUSSION—LARGE HOLE (+4 IN.)-QUARRY & WELL—"DOWN-THE-HOLE" TYPE ONLY*
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 — **South Milwaukee** — **Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St. New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy. Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71 — **333 Henry W Oliver Bldg. Pittsburgh 22** — **Pa**
Koehring Co — 3026 W Concordia, Milwaukee 16 — Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO.,
Adv. Pgs. 300-301 — **Sidney** — **Ohio**
Mission Mfg Co — Box 4209, Houston — Tex
MOBILE DRILLING INC., Adv Pg 325 — **960 N Pennsylvania St. Indianapolis 4** — **Ind**
Schramn Inc — 870 E Virginia Ave. West Chester — Pa
Winter Weiss Co — 2201 Blake St. Denver 5 — Colo

DRILLS (ROCK) PERCUSSION–*SMALL HOLE (–4 IN.)–"DOWN THE HOLE" TYPE ONLY*

BUCYRUS-ERIE CO., Adv. Pgs. 72, 312	**South Milwaukee**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
Winter Weiss Co	2201 Blake St. Denver 5	Colo

DRILLS (ROCK)–*PERCUSSION–SMALL HOLE (–4 IN.)*

ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312	**South Milwaukee**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 386-387	**Sidney**	**Ohio**
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
Parts, Inc	949 W Dunyle Ave. Salt Lake City 4	Utah

DRILLS (ROCK)–*ROTARY LARGE HOLE (+4 IN.)–QUARRY & WELL*

ACKER DRILL CO. INC., Adv Pg 360	**Box 838, Scranton**	**Pa**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312	**South Milwaukee**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Diamond Drill Contracting Co	1015 N Yardly Rd. Box 136, Spokane	Wash
Failing, George E., Co	Enid	Okla
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 386-387	**Sidney**	**Ohio**
Mayhew Machine & Supply Co	Box 7726, Dallas	Tex
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
Reichdrill Div. Chicago Pneumatic Drill Tool	Howard St. Franklin, Venango County	Pa
Schramm Inc	870 E Virginia Ave. West Chester	Pa
Winter Weiss Co	2201 Blake St. Denver 5	Colo

DRILLS (ROCK)–*ROTARY–SMALL HOLE (–4 IN.)*

ACKER DRILL CO. INC., Adv Pg 360	**Box 838, Scranton**	**Pa**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312	**South Milwaukee**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Fletcher, J. H. & Co	707 W 7th St. Huntington	W Va
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 386-387	**Sidney**	**Ohio**
Mayhew Machine & Supply Co	Box 7726, Dallas	Tex
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
Reichdrill Div. Chicago Pneumatic Drill Tool	Howard St. Franklin, Venango County	Pa
Schramm Inc	870 E Virginia Ave. West Chester	Pa
Winter Weiss Co	2201 Blake St. Denver 5	Colo

DRILLS (ROCK)–*ROTARY PERCUSSION–SMALL HOLE (–4 IN.)*

BUCYRUS-ERIE CO., Adv. Pgs. 72, 312	**South Milwaukee**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Fletcher, J. H. & Co	707 W 7th St. Huntington	W Va
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
Winter Weiss Co	2201 Blake St. Denver 5	Colo

DRILLS (ROCK)–*SELF–CONTAINED POWER–PACK–PORTABLE PERCUSSION*

ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
FLYGT CORP., Adv Pg 5	**Keosich Falls**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Hossfeld Manufacturing Co	Box 478, Winona	Minn
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**

DRILLS (ROCK)–*SELF–CONTAINED POWER–PACK–PORTABLE–ROTARY (& CORE)*

ACKER DRILL CO. INC., Adv Pg 360	**Box 838, Scranton**	**Pa**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
MOBILE DRILLING INC., Adv Pg 325	**960 N Pennsylvania St. Indianapolis 4**	**Ind**
NEW YORK ENGINEERING CO., Adv Pg 354	**76 West St. New York 6**	**NY**
Robbins Machine & Mfg Co	Oneonta	Ala
Sesscar, a Div of Sesmograph Service Corp	Box 1590, Tulsa 1	Okla
SPRAGUE & HENWOOD INC., Adv Pg 146	**221 W Olive St. Scranton**	**Pa**

DRILLS (ROCK & EARTH)–*WATER–JET–DOES NOT INCLUDE MONITORS*

Black & Decker Mfg Co	600 E Pennsylvania Ave. Towson	Md
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Koehring Co	3026 W Concordia, Milwaukee 16	Wis

DRIVERS–*MECHANICAL POWER TRANSMISSION–See Below–Also See CLUTCHES; COUPLINGS; POWER TAKE-OFFS; GEAR MOTORS*

DRIVES–*BELT*

ACME HAMILTON MFG CORP., Adv Pg 166	**Meade St. Trenton 3**	**NJ**
American Pulley Co	4200 Wissanickon Ave. Philadelphia 29	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Extrenultus, Inc	25-11 40 Ave. Long Island City 1	NY
Gates Rubber Co	999 S Broadway, Denver 17	Colo
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lovejoy Flexible Coupling Co	4932 W Lake St. Chicago 44	Ill
Morse Chain Co, Borg-Warner Industry	Ithaca	NY
National Supply Div. Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 83-83	**42 Townsend St. Passaic**	**NJ**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**266 Ridgeway Ave. Aurora**	**Ill**
Western Conveyor Co	Box 357, Boise	Idaho

DRIVES–*CHAIN*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
CHAIN BELT CO., Adv Pg 331	**4579 W Greenfield Ave. Milwaukee 1**	**Wis**
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Columbus McKinnon Corp. Mining Equipment Div	56 Fremont Ave. Tonawanda	NY
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Foote Bros Gear & Machine Corp, Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**357 W Third St. Pittsburg**	**Kan**
Morse Chain Co, Borg-Warner Industry	Ithaca	NY
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**266 Ridgeway Ave. Aurora**	**Ill**

DRIVES–*FLUID*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Dodge Mfg Corp	S Union St. Mishawaka	Ind
General Motors Corp, Allison Div	4700 W 10 St. Indianapolis 6	Ind
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Oilgear Co	1560 W Pierce St. Milwaukee 4	Wis
Rockwell Mfg Co	400 N Lexington Ave. Pittsburgh 8	Pa
Rockwell Spring & Axle Co, Timken-Detroit Axle Div	100 Clark St. Detroit 32	Mich
Twin Disc Clutch Co	Racine	Wis
Vickers Inc	Administrative & Eng Center, Detroit 32	Mich

DRIVES–*GEAR*

Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Century Electric Co	1806 Pine St. St Louis 3	Mo
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Cleveland Worm & Gear Div, Eaton Mfg Co	3300 E 80th St. Cleveland 4	Ohio
Cone-Drive Gears Div, Michigan Tool Co	7171 E McNichols Rd. Detroit 12	Mich
DeLaval-Holroyd, Inc	121 First Ave. Trenton 7	NJ
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Foote Bros Gear & Machine Corp	999 Beecher St. San Leandro	Cal
Foote Bros Gear & Machine Corp, Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
FULLER TRANSMISSIONS DIV. EATON MANUFACTURING CO., Adv Pg 303	**Kalamazoo**	**Mich**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
GENERAL ELECTRIC CO. GEAR MOTOR & TRANSMISSION COMPONENTS DEPT., Adv. Pgs. 74, 167, 304	**845 E 25 St. Paterson**	**NJ**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**357 W Third St. Pittsburg**	**Kan**
Morse Chain Co, Borg-Warner Industry	Ithaca	NY
Ohio Gear Co	1333 E 179 St. Cleveland 10	Ohio
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
Rockwell Spring & Axle Co, Timken-Detroit Axle Div	100 Clark St. Detroit 32	Mich
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**266 Ridgeway Ave. Aurora**	**Ill**
Sterling Electric Motors, Inc. A Sub of Hathaway Instruments, Inc	5401 Telegraph Rd. Los Angeles 22	Cal
Stroh Process Steel Co	Calif & Marvista Aves. Pittsburgh 12	Pa
Tool Steel Gear & Pinion Co	211 Township Ave. Cincinnati 16	Ohio
Tulsa Products Div. Vickers Inc	731 E First St. Tulsa 20	Okla
Twin Disc Clutch Co	Racine	Wis
Western Conveyor Co	Box 357, Boise	Idaho
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

DRIVES–*GEAR–SHAFT–MOUNTED*

Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
American Pulley Co	4200 Wissanickon Ave. Philadelphia 29	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Cone-Drive Gears Div, Michigan Tool Co	7171 E McNichols Rd. Detroit 12	Mich
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Dominion Engineering, Ltd	Box 220, Montreal, Quebec	Can
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Foote Bros Gear & Machine Corp	999 Beecher St. San Leandro	Cal
Foote Bros Gear & Machine Corp, Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
FULLER TRANSMISSIONS DIV. EATON MANUFACTURING CO., Adv Pg 303	**Kalamazoo**	**Mich**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
GENERAL ELECTRIC CO. GEAR MOTOR & TRANSMISSION COMPONENTS DEPT., Adv. Pgs. 74, 167, 304	**845 E 25 St. Paterson**	**NJ**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**357 W Third St. Pittsburg**	**Kan**
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**266 Ridgeway Ave. Aurora**	**Ill**
Sterling Electric Motors, Inc. A Sub of Hathaway Instruments, Inc	5401 Telegraph Rd. Los Angeles 22	Cal
Stroh Process Steel Co	Calif & Marvista Aves. Pittsburgh 12	Pa
Tulsa Products Div. Vickers Inc	731 E First St. Tulsa 20	Okla
U S Electrical Motors Inc	200 E Slauson Ave. Los Angeles 54	Cal
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

DRIVES–*MAGNETIC & EDDY–CURRENT*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Century Electric Co	1806 Pine St. St Louis 3	Mo
Cutler-Hammer, Inc	237 N 12 St. Milwaukee 1	Wis
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352	**4716 W Electric Ave. Milwaukee 46**	**Wis**
FULLER TRANSMISSIONS DIV. EATON MANUFACTURING CO., Adv Pg 303	**Kalamazoo**	**Mich**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

DRIVES–*VARIABLE SPEED*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
American Pulley Co	4200 Wissanickon Ave. Philadelphia 29	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Browning Mfg Co	Maysville	Ky
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Century Electric Co	1806 Pine St. St Louis 3	Mo
Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Clark Controller Co	1146 E 152 St. Cleveland 10	Ohio
Cleveland Worm & Gear Div, Eaton Mfg Co	3300 E 80th St. Cleveland 4	Ohio
Cutler-Hammer, Inc	237 N 12 St. Milwaukee 1	Wis
Dodge Mfg Corp	S Union St. Mishawaka	Ind
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Foote Bros Gear & Machine Corp	999 Beecher St. San Leandro	Cal
Foote Bros Gear & Machine Corp, Whitney Chain Co	4545 S Western Blvd. Chicago 9	Ill
FULLER TRANSMISSIONS DIV. EATON MANUFACTURING CO., Adv Pg 303	**Kalamazoo**	**Mich**
Gates Rubber Co	999 S Broadway, Denver 17	Colo
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
GENERAL ELECTRIC CO. GEAR MOTOR & TRANSMISSION COMPONENTS DEPT., Adv. Pgs. 74, 167, 304	**845 E 25 St. Paterson**	**NJ**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Lovejoy Flexible Coupling Co	4932 W Lake St. Chicago 44	Ill
Morse Chain Co, Borg-Warner Industry	Ithaca	NY
Oilgear Co	1560 W Pierce St. Milwaukee 4	Wis
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
Sterling Electric Motors, Inc. A Sub of Hathaway Instruments, Inc	5401 Telegraph Rd. Los Angeles 22	Cal
U S Electrical Motors Inc	200 E Slauson Ave, Los Angeles 54	Cal
Vickers Inc	Administrative & Eng Center, Detroit 32	Mich
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

DROP BALLS (QUARRIES)

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Baldwin-Lima-Hamilton Corp, Standard Steel Works Div	Burnham	Pa
Coeur D'Alenes Co	Wallace	Idaho
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Eagle Iron Works	262 Holcomb Ave, Des Moines 4	Iowa
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can

DRYERS–*ROTARY–HEATED DRUM*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**5 Main St. Lima**	**Ohio**
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Fairmont Machinery Co	Fairmont	W Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hack Engineering Co	124 Wazee Market, Denver	Colo
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**357 W Third St. Pittsburg**	**Kan**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3673 S Chase Ave. Milwaukee 1**	**Wis**
Pacific Foundry & Metallurgy Co	3100 Nineteenth St. San Francisco 10	Cal
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc	201 N Wells St. Chicago 6	Ill
Standard Steel Corp	5060 Boyle Ave. Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo

DRYERS–*INFRA–RED*

Booth Co, Inc	333 W 14 S, Salt Lake City 15	Utah
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn

DRYERS–*VIBRATING PAN–ELECTRICALLY HEATED*

Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill

DUST COLLECTORS & PRECIPITATORS–*DOES NOT INCLUDE CLASSIFIERS–CYCLONE–DRY: DRILL (ROCK) DUST COLLECTORS: FILTERS–AIR SCRUBBERS–AIR & WASTE GAS*

Aerotec Industries, Inc	Greenwich	Conn
AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
American Standard Industrial Div	Detroit 32	Mich
B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**5 Main St. Lima**	**Ohio**
Bemis Bros. Bag Co	408 Pine St, St Louis 2	Mo
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
BUELL ENGINEERING CO., Adv Pg 154	**123 William St. New York 38**	**NY**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DUCON CO. INC., Adv Pg 158	**153 E Second St. Mineola**	**NY**
Fuller Co, Sub of General American Transportation Corp	Catasauqua	Pa
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Graver Water Conditioning, Co, Union Tank Car Co, Div	216 W 14 St. New York 11	NY
The Johnson-March Corp	3018 Market St, Philadelphia 4	Pa
JOY MANUFACTURING CO., Adv. Pgs. 78-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**

Koppers Co. Inc. Metal Prod Div	200 Scott St. Baltimore 30	Md
Majac Inc	23rd St. Pittsburgh 15	Pa
Mayhew Machine & Supply Co	Box 7726, Dallas	Tex
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Northern Blower Div. Buell Engineering Co. Inc	6410 Barberton Ave. Cleveland	Wis
Research-Cottrell Inc	Bound Brook	NJ
Ridge Equipment Co	Fallentimber	Pa
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
Wallace & Tiernan Inc	Belleville 9	NJ
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 67 & 338	**1000 W 9 St. Los Angeles 15**	**Cal**
Westinghouse Electric Corp. Sturtevant Div	Hyde Park, Boston 36	Mass
Wheelabrator Corp	1474 S Byrkit St. Mishawaka	Ind

DUST SAMPLERS

Antipol Corp	407 Hill Arcade, Galesburg	Ill

ELECTRICAL CONDUIT—*RACEWAYS & FITTINGS—Also See* PIPE

Aluminum Co of America	1501 Alcoa Bldg. Pittsburgh 19	Pa
Byers, A. M. Co	Clark Bldg. Pittsburgh 22	Pa
Carlon Products Corp	Box 133, Aurora	Ohio
Chase Brass & Copper Co	236 Grand St. Waterbury 20	Conn
Chester Cable Corp	Oakland Ave. Chester	NY
Circle Wire & Cable Corp	5500 Maspeth Ave. Maspeth 78	NY
Ettco Wire & Cable Corp	75 Onderdonk Ave. Brooklyn 37	NY
General Cable Corp	730 Third Ave. New York 17	NY
Ideal Industries, Inc	1020 Park Ave. Sycamore	Ill
Line Material Industries, McGraw-Edison Co	700 W Michigan St. Milwaukee 1	Wis
National Electric Div. H. K. Porter Co. Inc	Porter Bldg. Pittsburgh 19	Pa
H. K. Porter Co. Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg. Cleveland 1**	**Ohio**
Reynolds Metals Co	Box 2345-ZK, Richmond 18	Va
Rome Cable Div of Alcoa	330 Ridge St. Rome	NY
Thomas & Betts Co	36 Butler St. Elizabeth 1	NJ
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

ELECTRIC BATTERIES—*STORAGE-DRY*

AGA Corp of America	P O Box 447, South Plainfield	NJ
General Battery & Ceramic Corp	Box 1262, Reading	Pa
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Gould-National Batteries Inc	1st Natl Bnnk, St Paul 1	Minn
Parts, Inc	949 W Qunyle Ave. Salt Lake City 4	Utah
Ray-O-Vac Co	212 E Washington Ave. Madison 10	Wis
U S RUBBER CO., Adv. Pgs. 107, 180	**1230 Ave of the Americas, New York 20**	**NY**
U S Rubber Co. Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY

ELECTRIC BATTERIES—*STORAGE-WET*

C & D Batteries, Div. Electric Autolite Co	Washington & Cherry Sts. Conshohocken	Pa
Nickel Alkaline Battery Div. The Electric Storage Battery Co	177 Main St. West Orange	NJ
ELECTRIC STORAGE BATTERY CO. EXIDE INDUSTRIAL MARKETING DIV., Adv Pg 332	**Rising Sun & Adams Ave. Philadelphia 20**	**Pa**
General Battery & Ceramic Corp	Box 1262, Reading	Pa
GOODRICH, B.F. CO. TRUCK & BUSTIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Gould-National Batteries Inc	1st Nat Bank, St Paul 1	Minn
Kersey Mfg Co., Inc	Box 151, Bluffield	Va
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave. Pittsburgh 8**	**Pa**
U S RUBBER CO., Adv. Pgs. 107, 180	**1230 Ave of the Americas, New York 20**	**NY**

ELECTRIC BATTERY CHARGERS

Automatic Switch Co	Hanover Rd., Florham Park	NJ
C & D Batteries, Div. Electric Autolite Co	Washington & Cherry Sts. Conshohocken	Pa
ELECTRIC STORAGE BATTERY CO. EXIDE INDUSTRIAL MARKETING DIV., Adv 332	**Rising Sun & Adams Ave. Philadelphia 20**	**Pa**
General Railway Signal Co	Rochester 2	NY
Gould-National Batteries Inc	1st Natl Bank, St Paul 1	Minn
Kearfott Div. General Precision, Inc	12690 Elmwood Ave. Cleveland 11	Ohio
Kersey Mfg Co., Inc	Box 151, Bluffield	Va
Lincoln Electric Co	22801 St Clair Ave. Cleveland 17	Ohio
Mancha Storage Battery Locomotive Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave. Pittsburgh 8**	**Pa**
Onan Div of Studebaker-Packard Corp	2515 University Ave. SE, Minneapolis 14	Minn
Perkin Electronics Corp	345 Kansas St. El Segundo	Cal
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo

ELECTRIC BATTERY TRANSFER RACKS

Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio

ELECTRIC CABLE & WIRE—*OTHER THAN BELOW*

Aluminum Co of America	1501 Alcoa Bldg. Pittsburgh 19	Pa
Anaconda Wire & Cable Co	25 Broadway, New York 4	NY
Chester Cable Corp	Oakland Ave. Chester	NY
Circle Wire & Cable Corp	5500 Maspeth Ave. Maspeth 78	NY
Collyer Insulated Wire Co	249 Roosevelt Ave. Pawtucket	RI
Ettco Wire & Cable Corp	75 Onderdonk Ave. Brooklyn 37	NY
General Cable Corp	730 Third Ave. New York 17	NY
Kaiser Aluminum & Chemical Sales	300 Lakeside Dr. Oakland 12	Cal
The Okonite Co	220 Passaic St. Passaic	NJ
PHELPS DODGE COPPER PRODUCTS, Adv Pg 165	**300 Park Ave. New York 22**	**NY**
H. K. Porter Co. Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
Reynolds Metals Co	Box 2346-ZK, Richmond 18	Va
Rockbestos Wire & Cable Co. Div of Cerro Corp	Nicoll & Canner Sts. New Haven 4	Conn
Rome Cable Div of Alcoa	330 Ridge St. Rome	NY
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Western Insulated Wire Co	2425 E 30th St. Los Angeles 58	Cal

ELECTRIC CABLE—*ARMORED*

American Steel & Wire Div. U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Anaconda Wire & Cable Co	25 Broadway, New York 4	NY
Chester Cable Corp	Oakland Ave. Chester	NY
Circle Wire & Cable Corp	5500 Maspeth Ave. Maspeth 78	NY
Collyer Insulated Wire Co	249 Roosevelt Ave. Pawtucket	RI
Columbia-Geneva Steel Div. U.S. Steel Corp	120 Montgomery St. San Francisco 6	Cal
Ettco Wire & Cable Corp	75 Onderdonk Ave. Brooklyn 37	NY
General Cable Corp	730 Third Ave. New York 17	NY
National Electric Div. H. K. Porter Co. Inc	Porter Bldg. Pittsburgh 19	Pa
National Tube Div. U.S. Steel Corp	525 William Penn Pl. Pittsburgh	Pa
The Okonite Co	220 Passaic St. Passaic	NJ
PHELPS DODGE COPPER PRODUCTS, Adv Pg 165	**300 Park Ave. New York 22**	**NY**
Rockbestos Wire & Cable Co. Div of Cerro Corp	Nicoll & Canner Sts. New Haven 4	Conn
Rome Cable Div of Alcoa	330 Ridge St. Rome	NY
SIMPLEX WIRE & CABLE CO., Adv Pg 173	**79 Sidney St. Cambridge 30**	**Mass**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**

ELECTRIC CABLE—*NON-METALLIC SHEATHED*

American Steel & Wire Div. U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Anaconda Wire & Cable Co	25 Broadway, New York 4	NY
Chester Cable Corp	Oakland Ave, Chester	NY
Circle Wire & Cable Corp	5500 Maspeth Ave, Maspeth 78	NY
Collyer Insulated Wire Co	249 Roosevelt Ave, Pawtucket	RI
Columbia-Geneva Steel Div. U.S. Steel Corp	120 Montgomery St. San Francisco 6	Cal
Ettco Wire & Cable Corp	75 Onderdonk Ave, Brooklyn 37	NY
General Cable Corp	730 Third Ave, New York 17	NY
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
National Electric Div. H. K. Porter Co. Inc	Porter Bldg. Pittsburgh 19	Pa
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
National Tube Div. U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
The Okonite Co	220 Passaic St. Passaic	NJ
PHELPS DODGE COPPER PRODUCTS, Adv Pg 165	**300 Park Ave. New York 22**	**NY**
H. K. Porter Co. Inc	Porter Bldg. 601 Grant St. Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
Rockbestos Wire & Cable Co. Div of Cerro Corp	Nicoll & Canner Sts. New Haven 4	Conn
Rome Cable Div of Alcoa	330 Ridge St. Rome	NY
SIMPLEX WIRE & CABLE CO., Adv Pg 173	**79 Sidney St. Cambridge 30**	**Mass**
Western Insulated Wire Co	2425 E 30th St. Los Angeles 58	Cal

ELECTRIC CABLE—*TRAILING*

Anaconda Wire & Cable Co	25 Broadway, New York 4	NY
Circle Wire & Cable Corp	5500 Maspeth Ave, Maspeth 78	NY
Collyer Insulated Wire Co	249 Roosevelt Ave, Pawtucket	RI
General Cable Corp	730 Third Ave, New York 17	NY
National Electric Div. H. K. Porter Co. Inc	Porter Bldg. Pittsburgh 19	Pa
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
The Okonite Co	220 Passaic St. Passaic	NJ
PHELPS DODGE COPPER PRODUCTS, Adv Pg 165	**300 Park Ave. New York 22**	**NY**
Rockbestos Wire & Cable Co. Div of Cerro Corp	Nicoll & Canner Sts. New Haven 4	Conn
Rome Cable Div of Alcoa	330 Ridge St. Rome	NY
SIMPLEX WIRE & CABLE CO., Adv Pg 173	**79 Sidney St. Cambridge 30**	**Mass**
Western Insulated Wire Co	2425 E 30th St. Los Angeles 58	Cal

ELECTRIC CABLE ACCESSORIES & FITTINGS

Aluminum Co of America	1501 Alcoa Bldg. Pittsburgh 19	Pa
Anaconda Wire & Cable Co	25 Broadway, New York 4	NY
G & W Electric Specialty Co	3500 W 127 St. Blue Island	Ill
General Cable Corp	730 Third Ave. New York 17	NY
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Ohio Brass Co	Mansfield	Ohio
The Okonite Co	220 Passaic St. Passaic	NJ
PLM PRODUCTS INC., Adv Pg 367	**3071 W 150 St. Cleveland 11**	**Ohio**
SIMPLEX WIRE & CABLE CO., Adv Pg 173	**79 Sidney St. Cambridge 39**	**Mass**
Thomas & Betts Co	36 Butler St. Elizabeth 1	NJ

ELECTRIC CABLE SPLICERS & VULCANIZERS

AMERICAN MINE DOOR CO., Adv Pg 324	**2839 Dueber Ave. SW, Canton 6**	**Ohio**
Flood City Brass & Electric Co	Johnstown	Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Ohio Brass Co	Mansfield	Ohio

ELECTRIC CONVERTERS DC TO AC *(DOES NOT INCLUDE ELECTRIC RECTIFIERS)*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Onan Div of Studebaker-Packard Corp	2515 University Ave. SW, Minneapolis 14	Minn
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Wincharger Corp. Sub of Zenith Radio Corp	Sioux City 2	Iowa

ELECTRIC GENERATORS—*DOES NOT INCLUDE ELECTRIC GENERATING POWER PLANTS; ELECTRIC CONVERTERS; ELECTRIC MOTOR-GENERATOR SET; ELECTRIC RECTIFIERS*

AGA Corp of America	P O Box 447, South Plainfield	NJ
ALLIS-CHALMERS MFG CO. INCUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Century Electric Co	1806 Pine St. St Louis 3	Mo
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Howell Electric Motors Co	16316 W Seven Mile Rd. Detroit 35	Mich
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Kearfott Div. General Precision, Inc	12690 Elmwood Ave, Cleveland 11	Ohio
Onan Div of Studebaker-Packard Corp	2515 University Ave. SE, Minneapolis 14	Minn
Reliance Electric & Engineering	24701 Euclid Ave. Cleveland 17	Ohio
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

ELECTRIC GENERATING POWER PLANTS—*MOBILE & MOVABLE*

Alco Products Inc	Dept. 915, Schenectady 5	NY
ALLIS-CHALMERS MFG CO. ENGINE-MATERIAL HANDLING DIV., Adv. Pgs. 56-57, 59	**1133 S 70 St. Milwaukee 14**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Brown Boveri Corp	19 Rector St. New York 6	NY
Dean Hill Corp	4000 E 16 St. Indianapolis 7	Ind
DETROIT DIESEL ENGINE DIV. GENERAL MOTORS CORP., Adv Pg 68	**13400 W Outer Dr. Detroit 28**	**Mich**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Hobart Bros Co	Main & Adams Sts. Troy 1	Ohio
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Minnesota Mining & Mfg Co	900 Bush Ave. St Paul 6	Minn
Murphy Diesel Co	5317 W Burnham St. Milwaukee 11	Wis
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Onan Div of Studebaker-Packard Corp	2515 University Ave. SE, Minneapolis 14	Minn
Ready Power Co	11231 Freud Ave, Detroit	Mich
Sheppard, R. H., & Co. Inc	Hanover	Pa
Solar Aircraft Co	2200 Pacific Hwy, San Diego 12	Cal
Waukesha Motor Co	Waukesha	Wis
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Wincharger Corp, Sub of Zenith Radio Corp	Sioux City 2	Iowa
Sheppard, R. H., & Co. Inc	Hanover	Pa

ELECTRIC GENERATING POWER PLANTS—*STATIONARY*

ALLIS-CHALMERS MFG CO. ENGINE-MATERIAL HANDLING DIV., Adv. Pgs. 56-57, 59	**1133 S 70 St. Milwaukee 14**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Brown Boveri Corp	19 Rector St. New York 6	NY
Dean Hill Corp	4000 E 16 St. Indianapolis 7	Ind
DETROIT DIESEL ENGINE DIV. GENERAL MOTORS CORP., Adv Pg 68	**13400 W Outer Dr. Detroit 28**	**Mich**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Enterprise Engine & Machinery Co	P O Box 2161, Oakland 21	Cal
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Kearfott Div. General Precision, Inc	12690 Elmwood Ave. Cleveland 11	Ohio
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Onan Div of Studebaker-Packard Corp	2515 University Ave. SE, Minneapolis 14	Minn
Ready Power Co	11231 Freud Ave. Detroit	Mich
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Wincharger Corp. Sub of Zenith Radio Corp	Sioux City 2	Iowa

ELECTRIC MOTOR CONTROLS & STARTERS—*Also See* CONTROLS: ELECTRIC MOTOR-GENERATOR SETS; ELECTRIC RESISTORS; ELECTRIC SWITCHGEAR

Allen-Bradley Co	136 W Greenfield Ave. Milwaukee 4	Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Clark Controller Co	1146 E 152 St. Cleveland 10	Ohio
Cutler-Hammer, Inc	237 N 12 St. Milwaukee 1	Wis
Durakool, Inc	1010 N Main St. Elkhart	Ind
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Guyan Machinery Co	755 Stratton St. Logan	W Va
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Linde Co. Union Carbide Corp	270 Park Ave. New York 17	NY
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
Ohio Brass Co	Mansfield	Ohio
Onan Div of Studebaker-Packard Corp	2515 University Ave. SE, Minneapolis 14	Minn
Reliance Electric & Engineering	24701 Euclid Ave. Cleveland 17	Ohio
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo
WEIGHING & CONTROLS, INC. SUB OF COMPUDYNE CORP., Adv Pg 347	**Industrial Park, E County Line Rd. Hatboro 10**	**Pa**
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

ELECTRIC-MOTOR GENERATOR SETS—*DOES NOT INCLUDE ELECTRIC CONVERTERS; ELECTRIC RECTIFIERS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Asea Electric, Inc	500 Fifth Ave. New York 36	NY
Carrier Corp	Carrier Pkwy. Syracuse 1	NY
Century Electric Co	1806 Pine St. St Louis 3	Mo
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Hillman, C. Kirk, Co. Inc	3201 First Ave. S, Seattle 4	Wash
Howell Electric Motors Co	16316 W Seven Mile Rd. Detroit 35	Mich
Ideal Electric & Mfg Co	First & Oak, Mansfield	Ohio
Kearfott Div. General Precision, Inc	12690 Elmwood Ave, Cleveland 11	Ohio
Mancha Storage Battery Locomotive Div. Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
Marble Electric Corp	Superior St. Gladstone	Mich
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
Vickers Inc. Electric Products Div	1815 Locust St. St Louis 3	Mo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Wincharger Corp. Sub of Zenith Radio Corp	Sioux City 2	Iowa

ELECTRIC MOTORS—*DOES NOT INCLUDE GEAR MOTORS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Allis, Louis, Co	427 E Stewart St. Milwaukee 1	Wis
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Brown Boveri Corp	19 Rector St. New York 6	NY
Carrier Corp	Carrier Pkwy. Syracuse 1	NY
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Hillman, C. Kirk, Co. Inc	3201 First Ave. S, Seattle 4	Wash
Howell Electric Motors Co	16316 W Seven Mile Rd. Detroit 35	Mich

Ideal Electric & Mfg Co ..... First & Oak, Mansfield ..... Ohio
Lincoln Electric Co ..... 22801 St Clair Ave, Cleveland 17 ..... Ohio
Marble Electric Corp ..... Superior St, Gladstone ..... Mich
Moore Co ..... 800 S Missouri, Marceline ..... Mo
Robbins & Myers Inc ..... 1345 Lagonda Ave, Springfield ..... Ohio
Sterling Electric Motors, Inc, A Sub of Hathaway Instruments, Inc ..... 5401 Telegraph Rd, Los Angeles 22 ... Cal
U S Electrical Motors Inc ..... 200 E Slauson Ave, Los Angeles 54 ... Cal
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**
Wincharger Corp, Sub of Zenith Radio Corp ..... Sioux City 2 ..... Iowa

ELECTRIC MOTORS–*PROTECTED*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Allis, Louis, Co ..... 427 E Stewart St, Milwaukee 1 ..... Wis
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Century Electric Co ..... 1806 Pine St, St Louis 3 ..... Mo
Fairbanks, Morse & Co ..... 600 S Michigan Ave, Chicago 5 Ill
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Howell Electric Motors Co ..... 16316 W Seven Mile Rd, Detroit 35 ..... Mich
Ideal Electric & Mfg Co ..... First & Oak, Mansfield ..... Ohio
Marble Electric Corp ..... Superior St, Gladstone ..... Mich
Reliance Electric & Engineering ..... 24701 Euclid Ave, Cleveland 17 ..... Ohio
Robbins & Myers Inc ..... 1345 Lagonda Ave, Springfield ..... Ohio
U S Electrical Motors Inc ..... 200 E Slauson Ave, Los Angeles 54 ... Cal
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*MECHANICAL*

Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo

ELECTRIC RECTIFIERS–*MERCURY ARC*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*MOTOR-GENERATOR SETS*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Century Electric Co ..... 1806 Pine St, St Louis 3 ..... Mo
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Kearfott Div, General Precision, Inc ..... 12690 Elmwood Ave, Cleveland 11 ..... Ohio
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*SELENIUM & RARE METAL*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
C & D Batteries, Div, Electric Autolite Co ..... Washington & Cherry Sts, Conshohocken ..... Pa
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
General Railway Signal Co ..... Rochester 2 ..... NY
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
International Rectifier Corp ..... 233 Kansas St, El Segundo ..... Cal
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
Kearfott Div, General Precision, Inc ..... 12690 Elmwood Ave, Cleveland 11 ..... Ohio
Kersey Mfg Co, Inc ..... Box 151, Bluefield ..... Va
Research-Cottrell Inc ..... Bound Brook ..... NJ
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*SYN-CHRONOUS CONVERTER*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*VACUUM TUBE (ELECTRONIC)*

Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Philips Electronic Instruments ..... 750 S Fulton Ave, Mt Vernon ..... NY
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RECTIFIERS–*SPECIAL OR OTHER THAN ABOVE*

International Rectifier Corp ..... 233 Kansas St, El Segundo ..... Cal
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC RESISTORS & RHEOSTATS

Allen-Bradley Co ..... 136 W Greenfield Ave, Milwaukee 4 ..... Wis
Clark Controller Co ..... 1146 E 152 St, Cleveland 10 ..... Ohio
Cutler-Hammer, Inc ..... 237 N 12 St, Milwaukee 1 ..... Wis
Daystrom, Inc, Weston Instruments Div ..... 614 Frelinghuysen Ave, Newark ..... NJ
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Gayan Machinery Co ..... 755 Stratton St, Logan ..... W Va
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Kersey Mfg Co, Inc ..... Box 151, Bluefield ..... Va
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC SWITCH-GEAR & SWITCHES–*Also See* ELECTRICAL BRUSHES; CONTROLS–*ELECTRICAL*; METERS–*ELECTRICAL*; ELECTRIC TROLLEY ACCESSORIES

Allen-Bradley Co ..... 136 W Greenfield Ave, Milwaukee 4 ..... Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Allis, Louis, Co ..... 427 E Stewart St, Milwaukee 1 ..... Wis
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Cutler-Hammer, Inc ..... 237 N 12 St, Milwaukee 1 ..... Wis
Durakool, Inc ..... 1010 N Main St, Elkhart ..... Ind
G & W Electric Specialty Co ..... 3500 W 127 St, Blue Island Ill
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Ideal Electric & Mfg Co ..... First & Oak, Mansfield ..... Ohio
Ohio Brass Co ..... Mansfield ..... Ohio
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC TRANSFORMERS–*Also See* UNIT SUBSTATIONS *Below*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Asea Electric, Inc ..... 500 Fifth Ave, New York 35 ..... NY
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Durakool, Inc ..... 1010 N Main St, Elkhart ..... Ind
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
General Railway Signal Co ..... Rochester 2 ..... NY
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
Kuhlman Electric Co ..... Box 288, Birmingham ..... Mich
Line Material Industries, McGraw-Edison Co ..... 700 W Michigan St, Milwaukee 1 ..... Wis
Moloney Electric Co ..... 5390 Bircher Blvd, St Louis 20 ..... Mo
H. K. Porter Co, Inc ..... Porter Bldg, 601 Grant St, Pittsburgh 19 ..... Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE
DIV., Adv Pg 160 ..... **601 Grant St. Pittsburgh 19** ..... **Pa**
Research-Cottrell Inc ..... Bound Brook ..... NJ
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
WESTINGHOUSE ELECTRIC CORP.
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC TROLLEY ACCESSORIES

AMERICAN BRATTICE CLOTH CORP.,
Adv Pg 364 ..... **Warsaw** ..... **Ind**
CREATIVE ELECTRIC SWITCHING DEVICE
CO., Adv Pg 354 ..... **4780 Crittenden Dr. Louisville 9** ..... **Ky**
Flood City Brass & Electric Co ..... Johnstown ..... Pa
The Forker Corp ..... 2044 Random Rd, Cleveland 6 ..... Ohio
Hammond, J. V., Co ..... Spangler ..... Pa
HACKOB & U S SIGNAL CO., Adv Pg 354 ..... **4777 Louisville Ave. Louisville 9** ..... **Ky**
Ohio Brass Co ..... Mansfield ..... Ohio
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
Wright Hoist Div, American Chain & Cable Co, Inc ..... 735 Hay St, York ..... Pa

ELECTRIC UNIT SUB-STATIONS

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Dresser-Ideco Co ..... 975 Michigan Ave, Columbus 8 ..... Ohio
G & W Electric Specialty Co ..... 3500 W 127 St, Blue Island Ill
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
Ideal Electric & Mfg Co ..... First & Oak, Mansfield ..... Ohio
Kuhlman Electric Co ..... Box 288, Birmingham ..... Mich
Moloney Electric Co ..... 5390 Bircher Blvd, St Louis 20 ..... Mo
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTRIC VOLTAGE REGULATORS

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Curtiss-Wright Corp ..... Box 110, Princeton ..... NJ
Engelhard Industries, Inc ..... 113 Astor St, Newark ..... NJ
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 ..... **Schenectady 5** ..... **NY**
International Rectifier Corp ..... 233 Kansas St, El Segundo ..... Cal
Line Material Industries, McGraw-Edison Co ..... 700 W Michigan St, Milwaukee 1 ..... Wis
Moloney Electric Co ..... 5390 Bircher Blvd, St Louis 20 ..... Mo
Perkin Electronics Corp ..... 345 Kansas St, El Segundo ..... Cal
Philips Electronic Instruments ..... 750 S Fulton Ave, Mt Vernon ..... NY
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
Vickers Inc, Electric Products Div ..... 1815 Locust St, St Louis 3 ..... Mo
WESTINGHOUSE ELECTRIC CORP.,
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ELECTROLYTIC CELLS & PROCESS EQUIPMENT *(SPECIAL)*

Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... **148 Cedar St. New York 6** ..... **NY**

ELEVATORS–*PLANT BUILDING*; MAN & MATERIAL–*DOES NOT INCLUDE CONVEYORS*; *HOISTS (MINE)*; ENGINE ACCESSORIES–*See Below and* DRIVES

CONNELLSVILLE CORP., Adv Pg 342 ..... **P O Box 677, Connellsville** ..... **Pa**
Vulcan Iron Works Co ..... 2960 S Fox, Englewood ..... Colo
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

ENGINE FILTERS–*OIL*

Fram Corp ..... 105 Pantucket Ave, E Providence ..... RI

ENGINES–*DIESEL*

Allis Chalmers Mfg Co, Construction Machinery Div ..... 1126 S 70 St, Milwaukee ..... Wis
ALLIS-CHALMERS MFG CO. ENGINE-MATERIAL HANDLING DIV., Adv. Pgs. 56-57, 59 ..... **1133 S 70 St. Milwaukee 14** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Baldwin-Lima-Hamilton Corp, Indl Expt Div ..... Philadelphia 42 ..... Pa
CATERPILLAR TRACTOR CO.,
Adv. Pgs. 36-37, 44, 310 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
CUMMINS ENGINE CO. INC., Adv. Pgs. 296-297 ..... **1000 Fifth St. Columbus** ..... **Ind**
DETROIT DIESEL ENGINE DIV. GENERAL MOTORS CORP., Adv Pg 60 ..... **13400 W Outer Dr. Detroit 28** ..... **Mich**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St. New York** ..... **NY**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
Enterprise Engine & Machinery Co ..... P O Box 2161, Oakland 21 ..... Cal
Fairbanks, Morse & Co ..... 600 S Michigan Ave, Chicago 5 Ill
HARNISCHFEGER CORP., Adv Pg 1 ..... **4444 W National Ave. Milwaukee 46** ..... **Wis**
Hercules Motors Co ..... 101-11 St. SE., Canton ..... Ohio
Lister-Blackstone Inc ..... 42-32 21st St, Long Island City 1 ..... NY
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
Murphy Diesel Co ..... 5317 W Burnham St, Milwaukee 11 ..... Wis
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave. Milwaukee 1** ..... **Wis**
Onan Div of Studebaker-Packard Corp ..... 2515 University Ave, SE, Minneapolis 14 ..... Minn
Page Engineering Co ..... Clearing Post Office, Chicago 38 Ill
Sheppard, R. H., & Co, Inc ..... Hanover ..... Pa
Waukesha Motor Co ..... Waukesha ..... Wis

ENGINES–*GAS & GASOLINE*

ALLIS-CHALMERS MFG CO. ENGINE-MATERIAL HANDLING DIV., Adv. Pgs. 56-57, 59 ..... **1133 S 70 St. Milwaukee 14** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Briggs & Stratton Corp ..... 2711 N 13 St, Milwaukee 1 ..... Wis
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St. New York** ..... **NY**
Enterprise Engine & Machinery Co ..... P O Box 2161, Oakland 21 ..... Cal
Fairbanks, Morse & Co ..... 600 S Michigan Ave, Chicago 5 Ill
FORD MOTOR CO., Adv. Pgs. 14-15 ..... **Box 658, Dearborn** ..... **Mich**
Hercules Motors Co ..... 101-11 St. SE., Canton ..... Ohio
Homelite, Div of Textron Inc ..... 75 Riverdale Ave, Port Chester ..... NY
McCulloch Corp, Los Angeles Div ..... 6101 W Century Blvd, Los Angeles 45 .. Cal
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave. Milwaukee 1** ..... **Wis**
Onan Div of Studebaker-Packard Corp ..... 2515 University Ave, SE, Minneapolis 14 ..... Minn
Waukesha Motor Co ..... Waukesha ..... Wis
Wisconsin Motor Corp ..... Milwaukee 46 ..... Wis

ENGINES–*HYDRAULIC TURBINE*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
COPPUS ENGINEERING CO., Adv Pg 305 ..... **344 Park Ave. Worcester 10** ..... **Mass**
Davis Foundry & Machine Works ..... Old Furnance Rd, Rome ..... Ga
Solosa Aircraft Co ..... 2200 Pacific Hwy, San Diego 12 ..... Cal

ENGINES–*STEAM*

Dean Hill Corp ..... 4000 E 16 St, Indianapolis 7 ..... Ind

ENGINE EXHAUST SCRUBBERS

ElmCO CORP., Adv Pg 335 ..... **501 W 6th South St. Salt Lake City 10** .. **Utah**
NATIONAL MINE SERVICE CO., Adv Pg 146 ..... **2530 Koppers Bldg. Pittsburgh 19** ..... **Pa**
Oxy-Catalyst Inc ..... 511 Old Lancaster Rd, Berwyn ..... Pa

EXCAVATORS–*BUCKETLINE*

Gar Wood Industries, Inc ..... Wayne ..... Mich
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Yaun Mfg Co, Inc ..... 2120 N Third St, Baton Rouge ..... La

EXCAVATORS–*BUCKET WHEEL*

BARBER-GREENE CO., Adv. Pgs. 168-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 ..... **South Milwaukee** ..... **Wis**
Gar Wood Industries, Inc ..... Wayne ..... Mich
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Co, Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **1133 St Clair Ave. NE, Cleveland 14** ..... **Ohio**
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla

EXCAVATORS–*CLAM SHELL & GRAB CRANE*

American Hoist & Derrick Co ..... 63 S Robert St, St Paul 7 ..... Minn
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124 ..... **5 Main St. Lima** ..... **Ohio**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 ..... **South Milwaukee** ..... **Wis**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
Gar Wood Industries, Inc ..... Wayne ..... Mich
HARNISCHFEGER CORP., Adv Pg 1 ..... **4444 W National Ave. Milwaukee 46** ..... **Wis**
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Speeder Corp ..... 1201-6 St. SW, Cedar Rapids ..... Iowa
MANITOWOC ENGINEERING CORP., Adv Pg 29 ..... **S 16 St. Manitowoc** ..... **Wis**
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131 ..... **Marion** ..... **Ohio**
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
NORTHWEST ENGINEERING CO., Adv Pg 13 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Orton Crane & Shovel Co ..... 608 S Dearborn St, Chicago 5 Ill
Robbins Machine & Mfg Co ..... Oneonta ..... Ala
Schield Bantam Co ..... 221 Park St, Waverly ..... Iowa
Thew Shovel Co ..... Lorain ..... Ohio
Unit Crane & Shovel Corp ..... 6411 W Burnham St, Milwaukee 19 ..... Wis
Yaun Mfg Co, Inc ..... 2120 N Third St, Baton Rouge ..... La

EXCAVATORS–*DIPPER SHOVEL*

American Hoist & Derrick Co ..... 63 S Robert St, St Paul 7 ..... Minn
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124 ..... **5 Main St. Lima** ..... **Ohio**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 ..... **South Milwaukee** ..... **Wis**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
ElmCO CORP., Adv Pg 335 ..... **501 W 6th South St. Salt Lake City 10** .. **Utah**
Gar Wood Industries, Inc ..... Wayne ..... Mich
HARNISCHFEGER CORP., Adv Pg 1 ..... **4444 W National Ave. Milwaukee 46** ..... **Wis**
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis

Link-Belt Speeder Corp ..... 1201-6 St. SW, Cedar Rapids ..... Iowa
MANITOWOC ENGINEERING CORP., Adv Pg 29 ..... **S 16 St. Manitowoc** ..... **Wis**
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131 ..... **Marion** ..... **Ohio**
NORTHWEST ENGINEERING CO., Adv Pg 13 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Orton Crane & Shovel Co ..... 608 S Dearborn St, Chicago 5 Ill
Quick-Way Truck Shovel Co ..... Box 1800, Denver 1 ..... Colo
Robbins Machine & Mfg Co ..... Oneonta ..... Ala
Schield Bantan Co ..... 221 Park St, Waverly ..... Iowa
Thew Shovel Co ..... Lorain ..... Ohio
Unit Crane & Shovel Corp ..... 6411 W Burnham St, Milwaukee 19 ..... Wis

EXCAVATORS—*DRAG-LINE CRANE*

American Hoist & Derrick Co ..... 63 S Robert St. St Paul 7 ..... Minn
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124 ..... **S Main St. Lima** ..... **Ohio**
BUCYRUS-ERIE CO., Adv. Pgs. 72, 312 ..... **South Milwaukee** ..... **Wis**
Dominion Engineering Co. Ltd ..... Box 220, Montreal, Quebec ..... Can
Gar Wood Industries, Inc ..... Wayne ..... Mich
HARNISCHFEGER CORP., Adv Pg 1 ..... **4444 W National Ave. Milwaukee 46** ..... **Wis**
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Link-Belt Speeder Corp ..... 1201-6 St. SW, Cedar Rapids ..... Iowa
MANITOWOC ENGINEERING CORP., Adv Pg 29 ..... **S 16 St. Manitowoc** ..... **Wis**
MARION POWER SHOVEL CO. UNIVERSAL MARION CORP., Adv. Pgs. 130-131 ..... **Marion** ..... **Ohio**
Midwestern Engine & Equipment Co ..... Box 1866, Tulsa ..... Okla
NORTHWEST ENGINEERING CO., Adv Pg 13 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Orton Crane & Shovel Co ..... 608 S Dearborn St, Chicago 5 Ill
Page Engineering Co ..... Clearing Post Office, Chicago 38 Ill
Quick-Way Truck Shovel Co ..... Box 1800, Denver 1 ..... Colo
Robbins Machine & Mfg Co ..... Oneonta ..... Ala
Schield Bantan Co ..... 221 Park St, Waverly ..... Iowa
Thew Shovel Co ..... Lorain ..... Ohio
Ubyn Mfg Co, Inc ..... 2120 N Third St, Baton Rouge ..... La
Unit Crane & Shovel Corp ..... 6411 W Burnham St, Milwaukee 19 ..... Wis

EXCAVATORS—*DRAG-LINE TOWER*

Dominion Engineering Co. Ltd ..... Box 220, Montreal, Quebec ..... Can
Page Engineering Co ..... Clearing Post Office, Chicago 38 Ill
SAUERMAN BROS. INC., Adv Pg 326 ..... **626 S 28 Ave. Bellwood** ..... **Ill**
Schield Bantan Co ..... 221 Park St, Waverly ..... Iowa
Unit Crane & Shovel Corp ..... 6411 W Burnham St, Milwaukee 19 ..... Wis

EXPLORATION EQUIPMENT—*See* SURVEYING EQUIPMENT; FOOD—PACKAGED KITS; TARPAULINS; GEOLOGIST'S EQUIP.; GEOPHYSICAL INSTRUMENTS; TRANSITS—POCKET

EXPLORATION SERVICE—*AERIAL*—*See* CONTRACTORS

EXPLOSIVES—*See* BLASTING COMPOUNDS

FANS & BLOWERS—*AIR & GAS*

Aerotec Industries, Inc ..... Greenwich ..... Conn
AMERICAN AIR FILTER CO. INC., Adv Pg 113 ..... **214 Central Ave. Louisville 8** ..... **Ky**
AMERICAN MACHINE & METALS, INC. DE BOTHEZAT FANS DIV., Adv. Pgs. 292-293 ..... **East Moline** ..... **Ill**
American Standard Industrial Div ..... Detroit 32 ..... Mich
Brown Boveri Corp ..... 19 Rector St, New York 6 ..... NY
Buffalo Forge Co ..... 490 Broadway, Buffalo 5 ..... NY
Clarage Fan Co ..... 1 Clarage Pl, Kalamazoo ..... Mich
COPPUS ENGINEERING CO., Adv Pg 305 ..... **344 Park Ave. Worcester 10** ..... **Mass**
Denver Fire Clay Co ..... 3033 Blake St. Denver 17 ..... Colo
Diehl Mfg Co ..... 1199 Fiderne Ave, Somerville ..... NJ
Duriron Co, Inc ..... 450 N Findlay St, Dayton 4 ..... Ohio
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Guyan Machinery Co ..... 755 Stratton St, Logan ..... W Va
Hartzell Propeller Fan Co ..... Box 909, Piqua ..... Ohio
Hillman, C. Kirk, Co, Inc ..... 3201 First Ave, S, Seattle 4 ..... Wash
Homelite, Div of Textron Inc ..... 75 Riverdale Ave, Port Chester ..... NY
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ..... **333 Henry W Oliver Bldg. Pittsburgh 22** ..... **Pa**
Lehigh Fan & Blower Div, Fuller Co ..... Catasauqua ..... Pa
MACHINERY CENTER INC., Adv Pg 355 ..... **Box 964, 1201 S 6 St. Salt Lake City 10** ..... **Utah**
Moore Co ..... 800 S Missouri, Marceline ..... Mo
H. K. Porter Co, Inc ..... Porter Bldg, 601 Grant St. Pittsburgh 19 ..... Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160 ..... **601 Grant St. Pittsburgh 19** ..... **Pa**
Robbins & Myers Inc ..... 1345 Lagonda Ave, Springfield ..... Ohio
Robinson Ventilating Co ..... 276 Hendrson St. Zelienople ..... Pa
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327 ..... **900 W Mount St. Connersville** ..... **Ind**
Sutorbilt Corp, Fuller Co ..... 2966 E Victoria St. Compton ..... Cal
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**
Westinghouse Electric Corp, Sturtevant Div ..... Hyde Park, Boston 36 ..... Mass

FASTENERS-SCREWS—*BOLTS-NAILS-SPIKES-NUTS-WASHERS-ETC.—DOES NOT INCLUDE ROCK & ROOF BOLTS; TIMBER CONNECTORS*

Aluminum Co of America ..... 1501 Alcoa Bldg, Pittsburgh 19 ..... Pa
American Steel & Wire Div, U.S. Steel Corp ..... 614 Superior NW, Cleveland 13 ..... Ohio
Ampco Metal, Inc ..... 1739 S 38 St. Milwaukee 1 ..... Wis
BETHLEHEM STEEL CO., Adv Pg 46 ..... **Bethlehem** ..... **Pa**
Chase Brass & Copper Co ..... 236 Grand St, Waterbury 20 ..... Conn
Clipper Belt Lacer Co ..... 974 Front St. NW, Grand Rapids 2 ..... Mich
Columbia-Geneva Steel Div, U.S. Steel Corp ..... 120 Montgomery St, San Francisco 6 ..... Cal
Commercial Shearing & Stamping Co ..... Dept. EMJ-MG, 1775 Logan Ave, Youngstown ..... Ohio
Eastern Sales Co, Div of The Eastern Co ..... Box 10821, Pittsburgh 36 ..... Pa
Elastic Stop Nut Corp of America ..... 2330 Vauxhall Rd, Union ..... NJ
Foster, L. B., Co ..... Box 1647, Pittsburgh 30 ..... Pa
Frank, M. K. ..... 480 Lexington Ave. New York 17 ..... NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Lamson & Sessions Co ..... 5000 Tiedeman Rd, Cleveland 9 ..... Ohio
National Lock Washer Co ..... 40 Hermon St. Newark ..... NJ
National Tube Div, U.S. Steel Corp ..... 525 William Penn Pl, Pittsburgh ..... Pa
Palnut Co, United-Car Fastener Corp ..... Glen Rd, Mountainside ..... NJ
REPUBLIC STEEL CORP., Adv Pg 161 ..... **Republic Bldg, Cleveland 1** ..... **Ohio**
Screw & Bolt Corp of America ..... Box 1708, Pittsburgh 30 ..... Pa
SHEFFIELD DIV. ARMCO STEEL CORP., Adv Pg 66 ..... **Sheffield Sta. Kansas City 25** ..... **Mo**

FEEDERS—*CHAIN (ROSS TYPE)*

Columbus McKinnon Corp, Mining Equipment Div ..... 56 Fremont Ave, Tonawanda ..... NY
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St. New York** ..... **NY**
Graver Water Conditioning Co. Union Tank Car Co. Div ..... 216 W 14 St. New York 11 ..... NY
Iowa Mfg Co ..... 916 16 St. NE, Cedar Rapids ..... Iowa
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Rogers Iron Works Co ..... Joplin ..... Mo
ROSS SCREEN & FEEDER CO., Adv Pg 351 ..... **100 Quimby St. Westfield** ..... **NJ**
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**

FEEDERS—*CONSTANT WEIGHT & WEIGHING—Also See* SCALES

B-I-F Industries, Inc ..... 345 Harris Ave, Providence 1 ..... RI
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St. York** ..... **Pa**
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342 ..... **470 S 10 E, Salt Lake City 2** ..... **Utah**
Infilco, Inc ..... 901 S Campbell Ave. Tucson ..... Ariz
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave. NE, Cleveland 14** ..... **Ohio**
MERRICK SCALE MFG CO., Adv Pg 338 ..... **184 Autumn St. Passaic** ..... **NJ**
Morse Bros Machinery Co ..... 2900 Brighton Blvd. Denver ..... Colo
Pioneer Engineering, Div of Poor & Co, Inc ..... 3200 Como Ave. SE, Minneapolis 14 ..... Minn
Richardson Scale Co ..... Clifton ..... NJ
Schaffer Poidometer Co ..... 2828 Smallman St. Pittsburgh 22 ..... Pa
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Thayer Scale ..... Pembroke ..... Mass
Toledo Scale Div, Toledo Scale Corp ..... 1112 Telegraph Rd, Toledo 12 ..... Ohio
Trans-Weigh Corp ..... Box 415, King of Prussia ..... Pa
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

FEEDERS—*CONVEYOR*

JAMESON FEEDER, INC., Adv Pg 163 ..... **Hookers** ..... **Pa**

FEEDERS—*REAGENT—DRY*

B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
Coeur D'Alenes Co ..... Wallace ..... Idah
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Infilco, Inc ..... 901 S Campbell Ave. Tucson ..... Ariz
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Morse Bros Machinery Co ..... 2900 Brighton Blvd. Denver ..... Colo
Pulva Corp ..... 602 High St. Perth Amboy ..... NJ
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

FEEDERS—*REAGENT—LIQUID*

B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
Clarkson Co ..... 735 Loma Verde Ave. Palo Alto ..... Cal
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Galigher Co ..... Box 209, Salt Lake City 10 ..... Utah
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342 ..... **470 S 10 E, Salt Lake City 2** ..... **Utah**
Infilco, Inc ..... 901 S Campbell Ave. Tucson ..... Ariz
Morse Bros Machinery Co ..... 2900 Brighton Blvd. Denver ..... Colo
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

FEEDERS—*RECIPROCATING PLUNGER*

B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
Clarkson Co ..... 735 Loma Verde Ave. Palo Alto ..... Cal
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Fairmont Machinery Co ..... Fairmont ..... W Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
HAMMERMILLS, INC., Adv Pg 376 ..... **625 C Ave. Cedar Rapids** ..... **Iowa**
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg, Fairmont ..... W Va
Iowa Mfg Co ..... 916 16 St. NE, Cedar Rapids ..... Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave. New York 22** ..... **NY**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McLANAHAN CORP., Adv Pg 328 ..... **Hollidaysburg** ..... **Pa**
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Rogers Iron Works Co ..... Joplin ..... Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Universal Road Machinery Co ..... Emerick St. Kingston ..... NY
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

FEEDERS—*REVOLVING DISK & PLATE*

B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
Bonded Scale & Machine Co ..... 38 Bellevue Ave. Columbus 7 ..... Ohio
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
DEISTER CONCENTRATOR CO. INC., Adv Pg 302 ..... **903 Glasgow Ave. Ft Wayne** ..... **Ind**
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St. York** ..... **Pa**
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave. New York 22** ..... **NY**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
NATIONAL IRON CO., Adv Pg 360 ..... **Ramsey St. & 80 Ave. W, Duluth 7** ..... **Minn**
Pioneer Engineering, Div of Poor & Co, Inc ..... 3200 Como Ave. SE, Minneapolis 14 ..... Minn
Pulva Corp ..... 602 High St. Perth Amboy ..... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa

FEEDERS—*ROTARY—DRUM*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wis**
Christian, J. D., Engineers ..... 480 Potrero Ave. San Francisco 10 ..... Cal
DEISTER CONCENTRATOR CO. INC., Adv Pg 302 ..... **903 Glasgow Ave. Ft Wayne** ..... **Ind**
DEISTER MACHINE CO., Adv Pg 358 ..... **1933 E Wayne St. Fort Wayne** ..... **Ind**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St. York** ..... **Pa**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Pulva Corp ..... 602 High St. Perth Amboy ..... NJ
Smith Engineering Works, Div of Barber-Greene ..... 5302 E Capitol Dr. Milwaukee 12 ..... Wis
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**

FEEDERS—*ROTARY—VANE*

B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Davis Foundry & Machine Works ..... Old Furnace Rd, Rome ..... Ga
Engineered Equipment, Inc ..... 1001 Linden Ave, Waterloo ..... Iowa
Fairmont Machinery Co ..... Fairmont ..... W Va
Fuller Co, Sub of General American Transportation Corp ..... Catasauqua ..... Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave. New York 22** ..... **NY**
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Pulva Corp ..... 602 High St. Perth Amboy ..... NJ
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**

FEEDERS—*VIBRATING—SHAKING—ETC. (PLATE—TABLE—ETC.)—DOES NOT INCLUDE GRIZZLIES OR SCREENS*

Ajax Flexible Coupling Co, Inc ..... Westfield ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St. Milwaukee 1** ..... **Wi**
B-I-F Industries, Inc ..... 345 Harris Ave. Providence 1 ..... RI
BARBER-GREENE CO., Adv. Pgs. 166-169 ..... **400 N Highland Ave. Aurora** ..... **Ill**
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
CHAIN BELT CO., Adv Pg 331 ..... **4679 W Greenfield Ave. Milwaukee 1** ..... **Wis**
Cleveland Vibrator Co ..... 2828 Clinton Ave. Cleveland 13 ..... Ohio
Diamond Iron Works Div, Goodman Mfg Co ..... Halsted St. & 48 Pl, Chicago 9 Ill
Oravo Corp ..... Neville Island, Pittsburgh 25 ..... Pa
ERIEZ MFG CO., Adv Pg 365 ..... **315 Magnet Dr. Erie** ..... **Pa**
Fairmont Machinery Co ..... Fairmont ..... W Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Hewitt-Robins, Inc ..... 666 Glenbrook Rd, Stamford ..... Conn
Industrial Engineering & Construction Co ..... 1st Natl Bank Bldg, Fairmont ..... W Va
Iowa Mfg Co ..... 916 16 St. NE, Cedar Rapids ..... Iowa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St. Pittsburg** ..... **Kan**
Ridge Equipment Co ..... Fallentimber ..... Pa
SIMPLICITY ENGINEERING CO., Adv Pg 340 ..... **Durand** ..... **Mich**
Smith Engineering Works, Div of Barber-Greene ..... 532 E Capitol Dr. Milwaukee 12 ..... Wis
Sorel Steel Foundries Ltd ..... 1405 Peel St. Montreal 2, P.Q. ..... Can
Southwestern Engineering Co ..... 4800 Santa Fe Ave. Los Angeles 58 ..... Cal
STEPHENS-ADAMSON MFG CO., Adv Pg 164 ..... **260 Ridgeway Ave. Aurora** ..... **Ill**
STRAUBE MFG CO., Adv Pg 359 ..... **6381 Baldwin St. Oakland 21** ..... **Cal**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa

FENCING—*METAL WIRE*

American Chain & Cable Co, Page Steel & Wire Div ..... Monessen ..... Pa
American Steel & Wire Div, U.S. Steel Corp ..... 614 Superior NW, Cleveland 13 ..... Ohio
BETHLEHEM STEEL CO., Adv Pg 46 ..... **Bethlehem** ..... **Pa**
Colorado Fuel & Iron Corp ..... 575 Madison Ave. New York 22 ..... NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **Continental Oil Bldg. Denver 2** ..... **Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp ..... 120 Montgomery St, San Francisco 6 ..... Cal
National Tube Div, U.S. Steel Corp ..... 525 William Penn Pl, Pittsburgh ..... Pa
REPUBLIC STEEL CORP., Adv Pg 161 ..... **Republic Bldg, Cleveland 1** ..... **Ohio**
SHEFFIELD DIV. ARMCO STEEL CORP., Adv Pg 66 ..... **Sheffield Sta. Kansas City 25** ..... **Mo**
U S STEEL CORP., Adv. Pgs. 12, 280 ..... **525 Wm Penn Pl. Pittsburgh 30** ..... **Pa**
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **575 Madison Ave. New York 22** ..... **NY**

FILTER BAGS

AMERICAN AIR FILTER CO. INC., Adv Pg 113 ..... **215 Central Ave. Louisville 8** ..... **Ky**
Bemis Bros. Bag Co ..... 408 Pine St. St Louis 2 ..... Mo
Daniels, C. R., Inc ..... Daniels ..... Wv
ElmCO CORP., Adv Pg 335 ..... **901 W 6th South St. Salt Lake City 10** ..... **NY**
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293 ..... **East Moline** ..... **Ill**
Fram Corp ..... 105 Pantucket Ave, E Providence ..... RI
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St. Chicago 3** ..... **Ill**
Koppers Co. Inc. Metal Prod Div ..... 200 Scott St. Baltimore 30 ..... Md
National Filter Media Corp ..... 1717 Dixwell Ave, New Haven 11 ..... Conn
Northern Blower Div, Buell Engineering Co, Inc ..... 6410 Barberton Ave. Cleveland ..... Ohio
Pendleton Woolen Mills ..... Box 655, Washougal ..... Wash
Peterson Filters & Engineering Co ..... 1949 S 2 W, Salt Lake City 10 ..... Utah
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
Wheelabrator Corp ..... 1474 S Byrkit St. Mishawaka ..... Ind

FILTER CLOTH

Colorado Fuel & Iron Corp ..... 575 Madison Ave. New York 22 ..... NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **Continental Oil Bldg. Denver 22** ..... **Colo**
Daniels, C. R., Inc ..... Daniels ..... Md
ElmCO CORP., Adv Pg 335 ..... **901 W 6th South St. Salt Lake City 10** ..... **Utah**
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293 ..... **East Moline** ..... **Ill**
Multi-Metal Wire Cloth Co, Inc ..... 1349 Garrison Ave, New York 59 ..... NY
National Filter Media Corp ..... 1717 Dixwell Ave, New Haven 11 ..... Conn
Newark Wire Cloth Co ..... 370 Verona Ave, Newark 4 ..... NJ
Pendleton Woolen Mills ..... Box 655, Washougal ..... Wash
Peterson Filters & Engineering Co ..... 1949 S 2 W, Salt Lake City 10 ..... Utah
Sly, W. W., Mfg Co ..... Box 5939, Cleveland 1 ..... Ohio
Tyler, W. S., Co ..... 3615 Superior Ave. Cleveland 14 ..... Ohio

Wellington Sears Co	111 W 40 St. New York 18	NY
Wheelabrator Corp	1474 S Byrkit St. Mishawaka	Ind
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

FILTER MEDIA *(OTHER THAN BAGS & CLOTH)*

AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2446 Nemours Bldg. Wilmington**	**Del**
Eagle - Picher Co	American Bldg. Cincinnati 1	Ohio
ElmCO CORP., Adv Pg 335	**901 W 6th South St. Salt Lake City 10**	**Utah**
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293	**East Moline**	**Ill**
Infilco, Inc	901 S Campbell Ave, Tucson	Ariz
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Multi-Metal Wire Cloth Co, Inc	1349 Garrison Ave, New York 59	NY
National Filter Media Corp	1717 Dixwell Ave, New Haven 11	Conn
Norton Co	1 New Bond St, Worcester 6	Mass
Peterson Filters & Engineering Co	1949 S 2 W, Salt Lake City 10	Utah

FILTERS—*See Below and* ENGINE FILTERS

FILTERS—*AIR-GAS & DUST*

Aerotec Industries, Inc	Greenwich	Conn
AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
Chicago Eye Shield Co	2727 W Roscoe St. Chicago 18	Ill
COPPUS ENGINEERING CO., Adv Pg 305	**344 Park Ave. Worcester 10**	**Mass**
Daniels, C. R., Inc	Daniels	Md
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DUCON CO. INC., Adv Pg 158	**153 E Second St. Mineola**	**NY**
Engelhard Industries, Inc	113 Astor St. Newark	NJ
Farr Co	Box 90187, Airport Sta. Los Angeles 45	Cal
Fram Corp	105 Pantucket Ave, E Providence	RI
Fuller Co. Sub of General American Transportation Corp	Catasauqua	Pa
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Victor Equipment Co, Alloy Rod & Metal Div	13808 E Imperial Hwy, Norwalk	Cal
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 47 & 338	**1900 W 9 St. Los Angeles 15**	**Cal**
Westinghouse Air Brake Co, Ind Products Div	P O Box 36, Wilmerding	Pa
Wheelabrator Corp	1474 S Byrkit St, Mishawaka	Ind

FILTERS (PROCESS)—*AIR-GAS & DUST*

Aerotec Industries, Inc	Greenwich	Conn
DUCON CO. INC., Adv Pg 158	**153 E Second St. Mineola**	**NY**
Dunnon Co., Inc	450 N Findlay St, Dayton 4	Ohio
Fram Corp	105 Pantucket Ave, E Providence	RI
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Koppers Co, Inc, Metal Prod Div	200 Scott St, Baltimore 30	Md
Oxy-Catalyst Inc	511 Old Lancaster Rd, Berwyn	Pa
Westinghouse Electric Corp, Sturtevant Div	Hyde Park, Boston 36	Mass
Wheelabrator Corp	1474 S Byrkit St, Mishawaka	Ind
Wilkerson Corp	1604 W Mansfield Ave, Englewood	Colo

FILTERS—*CONCENTRATE*

Bird Machine Co	South Walpole	Mass
Dagley Mfg Co	1217 E Sixth St, Joplin	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer Ln. Stamford**	**Conn**
Dunnon Co, Inc	450 N Findlay St, Dayton 4	Ohio
ElmCO CORP., Adv Pg 335	**901 W 6th South St. Salt Lake City 10**	**Utah**
FILTRATION ENGINEERS DIV. (FEINC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 292-293	**East Moline**	**Ill**
Gallagher Co	Box 209, Salt Lake City 10	Utah
Morse Bros Machinery Co	2900 Brighton Blvd, Denver	Colo
Peterson Filters & Engineering Co	1949 S 2 W, Salt Lake City 10	Utah

FILTERS—*ENGINE OIL*—See ENGINE FILTERS

FILTERS—*WATER & LIQUID*

B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Bird Machine Co	South Walpole	Mass
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Cochrane Div, Crane Co	17th St, below Allegheny Ave, Phila 32	Pa
Daniels, C. R., Inc	Daniels	Md
Dunnon Co, Inc	450 N Findlay St, Dayton 4	Ohio
ElmCO CORP., Adv Pg 335	**901 W 6th South St. Salt Lake City 10**	**Utah**
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Fisher Scientific Co	717 Forbes Ave, Pittsburgh 19	Pa
Fram Corp	105 Pantucket Ave, E Providence	RI
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Infilco, Inc	901 S Campbell Ave, Tucson	Ariz
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
Permutit Co, Div, Pfaudler Permutit Inc	50 W 44 St, New York 36	NY
Peterson Filters & Engineering Co	1949 S 2 W, Salt Lake City 10	Utah
Wilkerson Corp	1604 W Mansfield Ave, Englewood	Colo

FIRE FIGHTING EQUIPMENT AND SUPPLIES

American Rubber Mfg Co	1145 Park Ave, Oakland 8	Cal
Ansul Chemical Co	Marinette	Wis
Bullard, E. D., Co	2680 Bridgeway, Sausalito	Cal
Elkhart Brass Mfg Co, Inc	1302 W Beardsley Ave, Elkhart	Ind
FWD Corp	12 St, Clintonville	Wis
Fletcher, J. H. & Co	707 W 7th St, Huntington	W Va
Grinnell Co, Inc	260 W Exchange St, Providence 1	RI
Industrial Air Products Co	3200 N W Yeon Ave, Portland 10	Ore
Walter Kidde & Co, Inc	956 Main St, Belleville 9	NJ
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Onyx Chemical Corp	190 Warren St, Jersey City	NJ
Porto Pump Inc	19735 Ralston, Detroit 3	Mich
Scott Aviation Corp	Lancaster	NY
Stop-Fire Inc	U S Hwy 1 at Blackhorse Ln. New Brunswick	NJ
Walter Motor Truck Co	School Rd, Voorheesville	NY

FIRST AID EQUIPMENT & SUPPLIES

American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Bullard, E. D., Co	2680 Bridgeway, Sausalito	Cal
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Scott Aviation Corp	Lancaster	NY

FLOCCULATING REAGENTS—*Also See* WATER CLARIFICATION CHEMICALS

AMERICAN CYANAMID CO. EXPLOSIVES & MINING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
Armour Industrial Chemical Co	110 N Wacker Dr, Chicago 6	Ill
Burtonite Co	330 Passaic Ave, Nutley 10	NJ
Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
Ionac Chemical Co, Div, Pfaudler Permutit Inc	Birmingham	NJ
Nalco Chemical Co	6278 W 66th Pl, Chicago 38	Ill
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
Permutit Co, Div, Pfaudler Permutit Inc	50 W 44 St, New York 36	NY
PHILADELPHIA QUARTZ CO., Adv Pg 376	**1135 Public Ledger Bldg, Phila 6**	**Pa**
Stein, Hall & Co, Inc	285 Madison Ave, New York 17	NY

FLOOD LIGHTS—*ELECTRIC—Also See* LIGHTING FIXTURES & LAMPS

GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Guyan Machinery Co	755 Stratton St, Logan	W Va
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
Phoenix Products Co	4715 N 27 St, Milwaukee	Wis
Ray-O-Vac Co	212 E Washington Ave, Madison 10	Wis
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 158-159	**Box 2278, Pittsburgh 30**	**Pa**

FLOTATION MACHINES

Booth Co, Inc	333 W 14 S, Salt Lake City 15	Utah
Cannon Concentrator	1143 Sycamore St, Lakeland	Fla
Dagley Mfg Co	1217 E Sixth St, Joplin	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Gallagher Co	Box 209, Salt Lake City 10	Utah
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
Morse Bros Machinery Co	2900 Brighton Blvd, Denver	Colo
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc	201 N Wells St, Chicago 6	Ill
Western Machinery Co, Wemco Div	650 Fifth St, San Francisco 7	Cal

FLOTATION REAGENTS

Archer-Daniels-Midland Co	730 Investors Bldg, Minneapolis 1	Minn
Arizona Chemical Co	30 Rockefeller Plaza, New York 20	NY
Armour Industrial Chemical Co	110 N Wacker Dr, Chicago 6	Ill
Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Emery Industries, Inc	Carew Tower, Cincinnati 2	Ohio
General Mills, Inc	920 Wayzata Blvd, Minneapolis 26	Minn
HERCULES POWDER CO., Adv Pg 174	**910 Market St. Wilmington 99**	**Del**
NEVPORT INDUSTRIES DIV. HEYDEN NEVPORT CHEMICAL CORP., Adv Pg 321	**342 Madison Ave. New York 17**	**NY**
Pacific Lumber Co	100 Bush St. San Francisco 4	Cal
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
PHELPS DODGE REFINING CORP., Adv Pg 368	**300 Park Ave. New York 22**	**NY**
PHILADELPHIA QUARTZ CO., Adv Pg 376	**1135 Public Ledger Bldg, Phila 6**	**Pa**
Tennessee Corp	Grant Bldg, Atlanta	Ga

FOOD—*PACKAGED KITS*

Bolton Farm Packing Co	176 Oak St, Newton 64	Mass

FORGES—*BLACKSMITH—ETC.*

Buffalo Forge Co	490 Broadway, Buffalo 5	NY

FORGINGS—*DROP—ET AL*

ACF Industries, Inc, American Car & Foundry Div	750 Third Ave, New York 17	NY
American Brake Shoe Co	530 Fifth Ave, New York 36	NY
American Steel Foundries	Prudential Plaza, Chicago 1	Ill
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Ampco Metal, Inc	1739 S 38 St, Milwaukee 1	Wis
Atlas Steels, Ltd	Welland, Ontario	Can
Baldwin-Lima-Hamilton Corp, Standard Steel Works Div	Burnham	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Endicott Forging & Mfg Co	1901 North St, Endicott	NY
Ladish Co	5481 S Packard Ave, Cudahy	Wis
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Proto Tool Div, Pendleton Tool Industries	2209 Santa Fe Ave, Los Angeles 54	Cal
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont
SPANG & CO., Adv Pg 230	**143 Elm St. Butler**	**Pa**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**

FREEZEPROOFING MATERIALS—*DOES NOT INCLUDE CONCRETE ADDITIVES*

Wyandotte Chemicals Corp, Michigan Alkali Div	Wyandotte	Mich

FURNACES—*INDUSTRIAL PROCESS—COMBUSTION HEATED (HEATING—MELTING—ROASTING—SMELTING—CERAMIC—METALLURGICAL—REFRACTORY—ETC.)—DOES NOT INCLUDE BOILERS: BURNERS: DRYERS: HEATERS: LABORATORY EQUIPMENT: RETORTS: SINTERING EQUIPMENT: Also See BELOW AND* KILNS: CONVERTERS

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Engelhard Industries, Inc	113 Astor St, Newark	NJ
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Gould Gordon L, Co	58 Sutter St, San Francisco 4	Cal
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
Leeds & Northrup Co	4970 Stenton Ave, Philadelphia 44	Pa
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
Nichols Engineering & Research Corp	80 Pine St, New York 5	NY
Pacific Foundry & Metallurgy Co	3100 Nineteenth St, San Francisco 10	Cal
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
Surface Combustion Div, Midland-Ross Corp	2375 Dorr St, Toledo 1	Ohio
TREADWELL, N.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
Whiting Corp	157 & Lathrop, Harvey	Ill

FURNACES—*INDUSTRIAL PROCESS—ELECTRIC HEATED (HEATING—MELTING—ROASTING—SMELTING—CERAMIC—METALLURGICAL—REFRACTORY—ETC.)—DOES NOT INCLUDE BOILERS: BURNERS: DRYERS: HEATERS: LABORATORY EQUIPMENT: RETORTS: SINTERING EQUIPMENT: Also See BELOW AND* KILNS: CONVERTERS

American Bridge Div, U S Steel Corp	204 Frick Bldg, Pittsburgh 30	Pa
Ames Iron Works, Inc	25 E 2 St, Oswego	NY
Asea Electric, Inc	500 Fifth Ave, New York 36	NY
Brown Boveri Corp	19 Rector St, New York 6	NY
Curtiss-Wright Corp	Box 110, Princeton	NJ
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
ELEKTROKEMISK A. S., Adv Pg 358	**101 Park Ave. New York 17**	**NY**
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
Kuhlman Electric Co	Box 288, Birmingham	Mich
Lectromelt Furnace Div, McGraw Edison Co	Box 1257, Pittsburgh 30	Pa
Leeds & Northrup Co	4970 Stenton Ave, Philadelphia 44	Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
Surface Combustion Div, Midland-Ross Corp	2375 Dorr St, Toledo 1	Ohio
TREADWELL, N.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
Whiting Corp	157 & Lathrop, Harvey	Ill

FURNACES—*INDUSTRIAL PROCESS—FLUIDIZED SOLIDS*

DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer Ln. Stamford**	**Conn**

FURNACES—*INDUSTRIAL PROCESS—SHAFT (BLAST CUPOLA—ETC.)*

DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
Whiting Corp	157 & Lathrop, Harvey	Ill

FURNACES—*INDUSTRIAL PROCESS—STATIONARY HEARTH & REVERBERATORY*

Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
Surface Combustion Div, Midland-Ross Corp	2375 Dorr St, Toledo 1	Ohio

FURNACES—*SHOP & BENCH (HEAT TREATING—MELTING—FORGING—ETC.)—Also See* DRILL (ROCK) BIT & STEEL FORGING & HEAT TREATING FURNACES: FORGES: *DOES NOT INCLUDE LABORATORY EQUIPMENT*

Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
Engelhard Industries, Inc	113 Astor St, Newark	NJ
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
Surface Combustion Div, Midland-Ross Corp	2375 Dorr St, Toledo 1	Ohio

FURNACES—*SMELTING & ROASTING*

American Bridge Div, U S Steel Corp	204 Frick Bldg, Pittsburgh 30	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Gould Gordon L, Co	58 Sutter St, San Francisco 4	Cal
Lectromelt Furnace Div, McGraw Edison Co	Box 1257, Pittsburgh 30	Pa
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
Pacific Foundry & Metallurgy Co	3100 Nineteenth St, San Francisco 10	Cal
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
TREADWELL, N.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

FURNACE BURNERS—*See* BURNERS

FURNACE LININGS—*WALL & ARCHES—Also See* REFRACTORIES

Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Green Fire Brick Co	Mexico	Mo
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc	300 Lakeside Dr, Oakland 12	Cal
Norton Co	1 New Bond St, Worcester 6	Mass
H. K. Porter Co, Refractories Div	601 Grant St, Pittsburgh 19	Pa
Robinson Clay Product Co	65 W State St, Akron 9	Ohio

GAGES—*See* METERS

GALVANOMETERS—*See* METERS—*ELECTRICITY*

GASES—*INDUSTRIAL (OXYGEN—HYDROGEN—CARBON DIOXIDE—ACETYLENE—ETC.)*

Armour Industrial Chemical Co	110 N Wacker Dr, Chicago 6	Ill
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Industrial Air Products Co	3200 N W Yeon Ave, Portland 10	Ore
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY

GAS (& HUMIDITY) DETECTORS & INDICATORS—*Also See* METERS—*CHEMICAL*

Engelhard Industries, Inc	113 Astor St, Newark	NJ

GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 384 — **Schenectady 5** — **NY**
Hays Corp — 742 E & St, Michigan City — Ind

GAS GENERATORS

Engelhard Industries, Inc — 113 Astor St, Newark — NJ
Hevi-Duty Electric Co — 304 Hart St, Watertown — Wis
Linde Co, Union Carbide Corp — 270 Park Ave, New York 17 — NY
McDOWELL CO, INC, THE WELLMAN ENGINEERING CO., Adv Pg 366 — **113 St Clair Ave, NE, Cleveland 14** — **Ohio**
Rexarc Inc, Sight Feed Generator Div — P O Box 47, West Alexandria 2 — Ohio
Surface Combustion Div, Midland-Ross Corp — 2375 Dorr St, Toledo 1 — Ohio

GAS SEPARATION PROCESS EQUIPMENT *(SPECIAL)–DOES NOT INCLUDE DUST COLLECTORS OR STANDARD AUXILIARY EQUIPMENT*

Linde Co, Union Carbide Corp — 270 Park Ave, New York 17 — NY

GASKETS

Akron Metallic Gasket Co — 150 N Union St, Akron 9 — Ohio
Belmont Smelting & Refining Works — 330 Belmont Ave, Brooklyn 7 — NY
Continental Rubber Works — 1939 Liberty St, Erie — Pa
Durmon Co, Inc — 450 N Findlay St, Dayton 4 — Ohio
Eastern Sales Co, Div of The Eastern Co — Box 10821, Pittsburgh 36 — Pa
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3 — **500 S Main St, Akron 18** — **Ohio**
GOODYEAR TIRE & RUBBER CO., Adv Pg 11 — **1144 E Market St, Akron 16** — **Ohio**
Greene, Tweed & Co — North Wales — Pa
Gustin-Bacon Mfg Co — 210 W 10 St, Kansas City — Mo
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Johns-Manville — 22 E 40 St, New York 16 — NY
Keasbey & Mattison Co — Ambler — Pa
LINATEX CORP OF AMERICA, Adv Pg 159 — **P O Drawer D, Stafford Springs** — **Conn**
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83 — **42 Townsend St, Passaic** — **NJ**

GEAR MOTORS–*Also See* DRIVES: ELECTRIC MOTORS

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St, Milwaukee 1** — **Wis**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2 — Wash
Century Electric Co — 1806 Pine St, St Louis 3 — Mo
Christian, J. D., Engineers — 480 Potrero Ave, San Francisco 10 — Cal
Commercial Shearing & Stamping Co — Dept. EMJ-MG, 1775 Logan Ave, Youngstown — Ohio
Cone-Drive Gears Div, Michigan Tool Co — 7171 E McNichols Rd, Detroit 12 — Mich
DeLaval-Holroyd, Inc — 121 First Ave, Trenton 7 — NJ
Fairbanks, Morse & Co — 600 S Michigan Ave, Chicago 5 — Ill
FALK CORP., Adv Pg 34 — **Box 492, Milwaukee 1** — **Wis**
Foote Bros Gear & Machine Corp — 999 Beecher St, San Leandro — Cal
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 384 — **Schenectady 5** — **NY**
GENERAL ELECTRIC CO. GEAR MOTOR & TRANSMISSION COMPONENTS DEPT., Adv. Pgs. 74, 167, 384 — **845 E 25 St, Paterson** — **NJ**
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Howell Electric Motors Co — 16316 W Seven Mile Rd, Detroit 35 — Mich
Link-Belt Co, Dept. EMJ-61 — Prudential Plaza, Chicago 1 — Ill
Morse Chain Co, Borg-Warner Industry — Ithaca — NY
Ohio Gear Co — 1333 E 179 St, Cleveland 10 — Ohio
PHILADELPHIA GEAR CORP., Adv Pg 294 — **King of Prussia** — **Pa**
Reliance Electric & Engineering — 24701 Euclid Ave, Cleveland 17 — Ohio
Sterling Electric Motors, Inc, A Sub of Hathaway Instruments, Inc — 5401 Telegraph Rd, Los Angeles 22 — Cal
U S Electrical Motors Inc — 200 E Slauson Ave, Los Angeles 54 — Cal
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151 — **Box 2278, Pittsburgh 30** — **Pa**
Western Gear Corp, Industrial Pdts Div — Box 126, Belmont — Cal

GEAR PULLERS–*See* CAR WHEEL & GEAR PULLERS

GEARS & PINIONS–*METAL Also See BELOW*

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 — **389 E 14 St, Chicago Heights** — **Ill**
BIRDSBORO CORP., Adv Pg 136 — **Birdsboro** — **Pa**
Bitco, Inc — Box 2646, Terminal Annex, Spokane 2 — Wash
Christian, J. D., Engineers — 480 Potrero Ave, San Francisco 10 — Cal
Cone-Drive Gears Div, Michigan Tool Co — 7171 E McNichols Rd, Detroit 12 — Mich
DeLaval-Holroyd, Inc — 121 First Ave, Trenton 7 — NJ
Dominion Engineering Co, Ltd — Box 220, Montreal, Quebec — Can
FALK CORP., Adv Pg 34 — **Box 492, Milwaukee 1** — **Wis**
Flood City Brass & Electric Co — Johnstown — Pa
Foote Bros Gear & Machine Corp — 999 Beecher St, San Leandro — Cal
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 384 — **Schenectady 5** — **NY**
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Illinois Gear & Machine Co — 2108 N Natchez Ave, Chicago 35 — Ill
Jeffrey Mfg Co — 886 N 4th St, Columbus 16 — Ohio
Link-Belt Co, Dept. EMJ-61 — Prudential Plaza, Chicago 1 — Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 — **307 W Third St, Pittsburg** — **Kan**
Morse Chain Co, Borg-Warner Industry — Ithaca — NY
North American Gear Co — Box 7, Blairsville — Pa
Ohio Gear Co — 1333 E 179 St, Cleveland 10 — Ohio
Penn Machine Co — 905 H. K. Porter Bldg, Pittsburgh 19 — Pa
Penn Machine Co — 106 Station St, Johnstown — Pa
Penn Machine Co — P O Box 24, Huntington — W Va
PHILADELPHIA GEAR CORP., Adv Pg 294 — **King of Prussia** — **Pa**
Pittsburgh Gear Co — Neville Island, Pittsburgh 25 — Pa
Stahl Gear & Machine Co — 3901 Hamilton Ave, Cleveland 14 — Ohio
STEARNS ROGER MFG CO., Adv Pg 291 — **660 Bannock St, Denver 17** — **Colo**
STEPHENS-ADAMSON MFG CO., Adv Pg 164 — **260 Ridgeway Ave, Aumm** — **Ill**
Stroh Process Steel Co — Calif & Marvista Aves, Pittsburgh 12 — Pa
Tool Steel Gear & Pinion Co — 211 Township Ave, Cincinnati 16 — Ohio
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151 — **Box 2278, Pittsburgh 30** — **Pa**
Western Gear Corp, Industrial Pdts Div — Box 126, Belmont — Cal

GEARS & PINIONS–*METAL LARGE*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St, Milwaukee 1** — **Wis**

GEARS & PINIONS–*NON-METALLIC*

Christian, J. D., Engineers — 480 Potrero Ave, San Francisco 10 — Cal
Continental-Diamond Fibre Corp, Sub, Budd Co — Newark — Del
Dominion Engineering Co, Ltd — Box 220, Montreal, Quebec — Can
Flood City Brass & Electric Co — Johnstown — Pa
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Illinois Gear & Machine Co — 2108 N Natchez Ave, Chicago 35 — Ill
North American Gear Co — Box 7, Blairsville — Pa
Ohio Gear Co — 1333 E 179 St, Cleveland 10 — Ohio
PHILADELPHIA GEAR CORP., Adv Pg 294 — **King of Prussia** — **Pa**
Pittsburgh Gear Co — Neville Island, Pittsburgh 25 — Pa
Stahl Gear & Machine Co — 3901 Hamilton Ave, Cleveland 14 — Ohio
Synthane Corp — River Rd, Oaks — Pa
TREADWELL, W.H., CO. INC., Adv Pg 75 — **140 Cedar St, New York 6** — **NY**
Western Gear Corp, Industrial Pdts Div — Box 126, Belmont — Cal

GEIGER COUNTERS–*See* RADIATION DETECTORS

GEOLOGIST'S EQUIPMENT *(PICKS–POUCHES–ETC.)–DOES NOT INCLUDE SURVEYING INSTRUMENTS; DRAFTING EQUIPMENT; GEOPHYSICAL INSTRUMENTS; FOOD–PACKAGED KITS–LABORATORY EQUIP.*

Daniels, C. R., Inc — Daniels — Md
Geo-Optic & Paper Corp — 149 Church St, New York 7 — NY
Geophysical Instrument & Supply — 1616 Broadway, Denver 2 — Colo
Heinrichs Geoexploration Co — P O Box 5671, Tucson — Ariz
Philips Electronic Instruments — 750 S Fulton Ave, Mt Vernon — NY
Scott Williams Mineral Co, Inc — 440 N Scottsdale Rd, Scottsdale — Ariz

GEOPHYSICAL INSTRUMENTS–*DOES NOT INCLUDE RADIATION DETECTORS; ULTRA-VIOLET LIGHTS–Also See* METERS

BOULDER SCIENTIFIC, Adv Pg 375 — **250 Pearl St, Boulder** — **Colo**
Dresser Electronics/SIE Div — Box 22187, Houston — Tex
Dyna Metric, Inc — 2955 E Colorado Blvd, Pasadena — Cal
Exploration Methods, Inc — Box 100, Ishpeming — Mich
Fisher Research Laboratory, Inc — 1975 University Ave, Palo Alto — Cal
Geo-Optic & Paper Corp — 149 Church St, New York 7 — NY
Geophysical Instrument & Supply — 1616 Broadway, Denver 2 — Colo
Geophysical Specialties Co — 15409 Robinwood Dr, Hopkins — Minn
Heinrichs Geoexploration Co — P O Box 5671, Tucson — Ariz
KELLOGG EXPLORATION CO., Adv Pg 344 — **3301 H Hermosa Ave, Altadena** — **Cal**
Moran Instrument Corp — 170 E Orange Grove Ave, Pasadena 3 — Cal
VARIAN ASSOCIATES, Adv Pg 128 — **611 Hansen Way, Palo Alto** — **Cal**

GRADERS–*ROADS–TOWED & SELF-PROPELLED*

Allis Chalmers Mfg Co, Construction Machinery Div — 1126 S 70 St, Milwaukee — Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St, Milwaukee 1** — **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 — **969 S 70 St, Milwaukee 1** — **Wis**
Austin-Western, Construction Equipment Div, Baldwin-Lima-Hamilton Corp — Aurora — Ill
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 — **Peoria** — **Ill**
Galion Iron Works — Galion — Ohio
HUBER-WARCO CO., Adv Pg 155 — **Marion** — **Ohio**
Jeffrey Mfg Co — 886 N 4th St, Columbus 16 — Ohio
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65 — **2301 H Adams St, Peoria** — **Ill**
Midwestern Engine & Equipment Co — Box 1886, Tulsa — Okla
Pettibone Mulliken Corp — 4710 W Division St, Chicago 51 — Ill
Robbins Machine & Mfg Co — Oneonta — Ala

GRATINGS–*FLOOR*

Aluminum Co of America — 1501 Alcoa Bldg, Pittsburgh 19 — Pa
Blaw-Knox Co — 300 Sixth Ave, Pittsburgh 22 — Pa
Dravo Corp — Neville Island, Pittsburgh 25 — Pa
HENDRICK MFG CO., Adv Pg 77 — **Carbondale** — **Pa**
Irving Subway Grating Co, Inc — 50-99 27th St, Long Island City 1 — NY
Ryerson & Son, Inc — Box 8000A, Chicago 80 — Ill

GRINDERS & BUFFERS–*See BELOW; Also See* DRILL (ROCK) BIT & STEEL GRINDERS

ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave, New York 17** — **NY**
Black & Decker Mfg Co — 600 E Pennsylvania Ave, Towson — Md
Dominion Engineering Co, Ltd — Box 220, Montreal, Quebec — Can
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**

GRINDERS & BUFFERS–*ELECTRIC*

Black & Decker Mfg Co — 600 E Pennsylvania Ave, Towson — Md
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St, New York 17** — **NY**
Porter-Cable Machine Co — 700 Marcellus St, Syracuse 4 — NY
Remington Arms Co, Inc — 939 Barnum Ave, Bridgeport 2 — Conn
Thor Power Tool Co — 175 N State St, Aurora — Ill

GRINDERS & BUFFERS–*PNEUMATIC*

ATLAS COPCO, INC., Adv. Pgs. 54-55 — **545 Fifth Ave, New York 17** — **NY**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 — **6 E 44th St, New York 17** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 — **11 Broadway, New York 4** — **NY**
Remington Arms Co, Inc — 939 Barnum Ave, Bridgeport 2 — Conn
Thor Power Tool Co — 175 N State St, Aurora — Ill

GRINDING (& CUTTING) WHEELS

Bay-State Abrasive Products Co — 12 Union St, Westboro — Mass
Black & Decker Mfg Co — 600 E Pennsylvania Ave, Towson — Md
DIAMOND TOOL RESEARCH CO. INC., Adv Pg 363 — **380 Second Ave, New York 10** — **NY**
GARDNER DENVER CO., Adv. Pgs. 142-143 — **Gardner Expwy, Quincy** — **Ill**
Macklin Co — 2917 Wildwood Rd, Jackson — Mich
Norton Co — 1 New Bond St, Worcester 6 — Mass
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83 — **42 Townsend St, Passaic** — **NJ**
U S Rubber Co, Mechanical Goods Div — 1230 Ave of the Americas, New York 20 — NY

GRIZZLIES–*FEEDING & MOVING*

BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124 — **S Main St, Lima** — **Ohio**
CHAIN BELT CO., Adv Pg 331 — **4679 W Greenfield Ave, Milwaukee 1** — **Wis**
Davis Foundry & Machine Works — Old Furnace Rd, Rome — Ga
Diamond Iron Works Div, Goodman Mfg Co — Halsted St, & 48 Pl, Chicago 9 — Ill
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Iowa Mfg Co — 916 16 St, NE, Cedar Rapids — Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 — **405 Park Ave, New York 22** — **NY**
McLANAHAN CORP., Adv Pg 320 — **Hollidaysburg** — **Pa**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 — **3073 S Chase Ave, Milwaukee 1** — **Wis**
Rogers Iron Works Co — Joplin — Mo
ROSS SCREEN & FEEDER CO., Adv Pg 351 — **100 Grimby St, Westfield** — **NJ**
SIMPLICITY ENGINEERING CO., Adv Pg 349 — **Durand** — **Mich**
Smith Engineering Works, Div of Barber-Greene — 532 E Capitol Dr, Milwaukee 12 — Wis
STEPHENS-ADAMSON MFG CO., Adv Pg 164 — **260 Ridgeway Ave, Aumora** — **Ill**
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 — **Mill St, Allentown** — **Pa**
Tyler, W. S., Co — 3615 Superior Ave, Cleveland 14 — Ohio
Universal Engineering Corp — 625 C Ave, NW, Cedar Rapids — Iowa

GRIZZLIES–*STATIONARY*

BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124 — **S Main St, Lima** — **Ohio**
Bixby-Zimmer Engr Co — 961 Allbingdon St, Galesburg — Ill
CARD, C. S., IRON WORKS, Adv Pg 356 — **2501 W 16th Ave, Denver 4** — **Colo**
CHAIN BELT CO., Adv Pg 331 — **4679 W Greenfield Ave, Milwaukee 1** — **Wis**
Davis Foundry & Machine Works — Old Furnace Rd, Rome — Ga
Hewitt-Robins, Inc — 666 Glenbrook Rd, Stamford — Conn
Iowa Mfg Co — 916 16 St, NE, Cedar Rapids — Iowa
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 — **405 Park Ave, New York 22** — **NY**
Link-Belt Co, Dept. EMJ-61 — Prudential Plaza, Chicago 1 — Ill
Pioneer Engineering, Div of Poor & Co, Inc — 3200 Como Ave, SE, Minneapolis 14 — Minn
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc — 201 N Wells St, Chicago 6 — Ill
STEPHENS-ADAMSON MFG CO., Adv Pg 164 — **260 Ridgeway Ave, Aumora** — **Ill**
TRAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26-27, 28 — **Mill St, Allentown** — **Pa**
Universal Engineering Corp — 625 C Ave, NW, Cedar Rapids — Iowa

GROUT PUMPS–*See* CONCRETE: PUMPS

GROUTING–*BONDING & TESTING MATERIALS–DOES NOT INCLUDE CEMENT OR CONCRETE ADDITIVES*

HALLIBURTON CO., Adv Pg 123 — **Drawer 1431, Duncan** — **Okla**
The Rockaron Co, Ltd — P O Box 1089, Sudbury — Ont

HARDFACING ALLOYS & RODS–*Also See* METALLIZING: WELDING: COATINGS–*DOES NOT INCLUDE LININGS*

ALLOY RODS CO., Adv Pg 329 — **Box 1828, York** — **Pa**
American Brake Shoe Co — 530 Fifth Ave, New York 36 — NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 — **389 E 14 St, Chicago Heights** — **Ill**
American Chain & Cable Co, Page Steel & Wire Div — Monessen — Pa
Ampco Metal, Inc — 1739 S 38 St, Milwaukee 1 — Wis
Arcos Corp — 1500 S 50 St, Philadelphia 43 — Pa
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343 — **P O Box 88, Pittsburgh 30** — **Pa**
Eutectic Welding Alloys Corp — 40-40 172 St, Flushing 58 — NY
Haynes Stellite Co, Div, Union Carbide Corp — Kokomo — Ind
Huntington Alloy Products Div, The International Nickel Co, Inc — Huntington 17 — W Va
Industrial Air Products Co — 3200 N W Yeon Ave, Portland 10 — Ore
Kennametal Inc, Mining Tool Div — Bedford — Pa
Lincoln Electric Co — 22801 St Clair Ave, Cleveland 17 — Ohio
Linde Co, Union Carbide Corp — 270 Park Ave, New York 17 — NY
Rexarc Inc, Sight Feed Generator Div — P O Box 47, West Alexandria 2 — Ohio
STOODY CO., Adv Pg 314 — **Box 901, Whittier** — **Cal**
Taylor Wharton Div, Harsco Corp — High Bridge — NJ
Victor Equipment Co, Alloy Rod & Metal Div — 13808 E Imperial Hwy, Norwalk — Cal

HEATERS–*See BELOW; Also See* BOILERS: DRYERS: FURNACES: KILNS: RETORTS: SCREEN HEATERS: BURNERS

HEATERS–*PROCESS AIR & GAS (PREHEATERS–RECUPERATORS–REGENERATORS–ETC.)–DOES NOT INCLUDE BURNERS ALONE*

Engelhard Industries, Inc — 113 Astor St, Newark — NJ
Farris Corp — 430 Commercial Ave, Palisades Park — NJ
Farris Flexible Valve Corp — 463 Commercial Ave, Palisades Park — NJ
Fuller Co, Sub of General American Transportation Corp — Catasauqua — Pa

Majac Inc	23rd St. Pittsburgh 15	Pa
Rockwell, W. S., Co	200 Eliot St. Fairfield	Conn
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 67 & 338	**1000 W 9 St. Los Angeles 15**	**Cal**

HEATERS—*SPACE—DOES NOT INCLUDE BOILERS: FURNACES: KILNS: OR BURNERS ALONE*

AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave. Louisville 8**	**Ky**
Daniels, C. R., Inc	Daniels	Md
Driwo Corp	Neville Island, Pittsburgh 25	Pa
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 384	**Schenectady 5**	**NY**
Guyan Machinery Co	755 Stratton St. Logan	W Va
Houck Mfg Co. Equipment Div	124-136 10 St. Brooklyn 15	NY

HEAT EXCHANGERS—*Also See BOILERS: HEATERS: COOLERS*

Alco Products Inc	Dept. 915, Schenectady 5	NY
American Standard Industrial Div	Detroit 32	Mich
Babcock & Wilcox Co	161 E 42nd St. New York 17	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Canadian Industries, Ltd	Box 10, Montreal	Can
Cochrane Div. Crane Co	17th St. below Allegheny Ave. Phila 32	Pa
Combustion Engineering, Inc	200 Madison Ave. New York 16	NY
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 329	**82 Beaver St. New York**	**NY**
Dunron Co. Inc	450 N Findlay St. Dayton 4	Ohio
Electric Steel Foundry Co	714 NW 25 Ave. Portland 10	Ore
National Carbon Co. Union Carbide Corp	270 Park Ave. New York 17	NY
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 67 & 338	**1000 W 9 St. Los Angeles 15**	**Cal**
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

HEAVY MEDIA RECOVERY UNITS—*FOR ORE PROCESSING UNITS—See SEPARATORS—HEAVY MEDIA*

DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
Fairmont Machinery Co	Fairmont	W Va
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Western Machinery Co, Wenco Div	650 Fifth St. San Francisco 7	Cal

HOIST CONTROLS & ACCESSORIES—*MINE SHAFT—Also See CONTROLS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Clark Controller Co	1146 E 152 St. Cleveland 10	Ohio
Cutler-Hammer, Inc	237 N 12 St. Milwaukee 1	Wis
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 384	**Schenectady 5**	**NY**
Guyan Machinery Co	755 Stratton St. Logan	W Va
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
LOGAN ENGINEERING CO., Adv Pg 361	**4901 W Lawrence Ave. Chicago 30**	**Ill**
Manning, Maxwell & Moore Inc. Shaw Box Crane & Hoist Div	Muskegon	Mich
Shepard Niles Crane & Hoist Corp	Schuyler Ave. Montour Falls	NY
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Yale & Towne Mfg Co. Yale Materials Handling Div	11000 Roosevelt Blvd. Philadelphia 15	Pa

HOISTS—*See BELOW: REFER TO WINCHES FOR TYPE OF POWER: Also See CRANES*

HOISTS—*DRAGLINE SCRAPER-SLUSHER*

ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Lidgerwood Mfg Co	7 Dey St. New York	NY
SAUERMAN BROS. INC., Adv Pg 326	**626 S 28 Ave. Bellwood**	**Ill**
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

HOISTS—*DREDGE—CRANE & SHOVEL TYPES*

American Hoist & Derrick Co	63 S Robert St. St Paul 7	Minn
Austin-Western, Construction Equipment Div, Baldwin-Lima-Hamilton Corp	Aurora	Ill
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
Eagle Iron Works	262 Holcomb Ave. Des Moines 4	Iowa
Georgia Iron Works Co	605 12th St. Augusta	Ga
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lidgerwood Mfg Co	7 Dey St. New York	NY
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
Reading Crane & Hoist Corp	Box 1139, Reading	Pa
Superior-Lidgerwood-Mundy Corp	1101 John Ave. Superior	Wis
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

HOISTS—*LIFT—HAND CHAIN & RATCHET*

Chisholm-Moore Hoist Div, Columbus McKinnon Corp	5045 Fremont Ave. Tonawanda	NY
Coffing Hoist Div, Duff-Norton Co	800 Walter St. Danville	Ill
Columbus McKinnon Corp. Mining Equipment Div	56 Fremont Ave. Tonawanda	NY
Duff Norton Co	4 Gateway Center, Pittsburgh 22	Pa
The Parker Corp	2044 Random Rd. Cleveland 6	Ohio
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Harrington Co	Gravers Rd. Plymouth Meeting	Pa
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Manning, Maxwell & Moore Inc. Shaw Box Crane & Hoist Div	Muskegon	Mich
Reading Crane & Hoist Corp	Box 1139, Reading	Pa
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Thor Power Tool Co	175 N State St. Aurora	Ill
Wright Hoist Div. American Chain & Cable Co, Inc	735 Hay St. York	Pa
Yale & Towne Mfg Co. Yale Materials Handling Div	11000 Roosevelt Blvd. Philadelphia 15	Pa

HOISTS—*LIFT—SHOP TYPE PORTABLE & MOVABLE—DOES NOT INCLUDE HOISTS—LIFT—HAND CHAIN*

CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Chisholm-Moore Hoist Div, Columbus McKinnon Corp	5045 Fremont Ave. Tonawanda	NY
Coffing Hoist Div, Duff-Norton Co	800 Walter St. Danville	Ill
The Parker Corp	2044 Random Rd. Cleveland 6	Ohio
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lidgerwood Mfg Co	7 Dey St. New York	NY
Manning, Maxwell & Moore Inc. Shaw Box Crane & Hoist Div	Muskegon	Mich
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Yale & Towne Mfg Co. Yale Materials Handling Div	11000 Roosevelt Blvd. Philadelphia 15	Pa

HOISTS—*LIFT—SHOP TYPE STATIONARY*

Chisholm-Moore Hoist Div, Columbus McKinnon Corp	5045 Fremont Ave. Tonawanda	NY
Essick Mfg Co	1950 Santa Fe Ave. Los Angeles 21	Cal
The Parker Corp	2044 Random Rd. Cleveland 6	Ohio
Galland Henning Mfg Co. Nopak Div	2753 S 31 St. Milwaukee 46	Wis
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave. Milwaukee 46**	**Wis**
Harrington Co	Gravers Rd. Plymouth Meeting	Pa
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
LeTourneau Inc	2390 S MacArthur St. Longview	Tex
Lidgerwood Mfg Co	7 Dey St. New York	NY
Manning, Maxwell & Moore Inc. Shaw Box Crane & Hoist Div	Muskegon	Mich
Reading Crane & Hoist Corp	Box 1139, Reading	Pa
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Shepard Niles Crane & Hoist Corp	Schuyler Ave. Montour Falls	NY
Yale & Towne Mfg Co. Yale Materials Handling Div	11000 Roosevelt Blvd. Philadelphia 15	Pa

HOISTS—*MINE SHAFT DRUM—DOES NOT INCLUDE SHEAVES: SKIPS & CAGES: BUCKETS*

Christian, J. D., Engineers	480 Potrero Ave. San Francisco 10	Cal
Coeur D'Alenes Co	Wallace	Idah
Essick Mfg Co	1950 Santa Fe Ave. Los Angeles 21	Cal
Lidgerwood Mfg Co	7 Dey St. New York	NY
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
NATIONAL IRON CO., Adv Pg 360	**Ramsey St. & 58 Ave. W, Duluth 7**	**Minn**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
Superior-Lidgerwood-Mundy Corp	1101 John Ave. Superior	Wis
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo
Washington Iron Works	1500 6 Ave. S, Seattle 4	Wash

HOISTS—*MINE SHAFT FRICTION—DOES NOT INCLUDE SHEAVES—SKIPS & CAGES: BUCKETS*

Asea Electric, Inc	500 Fifth Ave. New York 36	NY
CONNELLSVILLE CORP., Adv Pg 342	**P O Box 677, Connellsville**	**Pa**
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
Lidgerwood Mfg Co	7 Dey St. New York	NY
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357	**Box 1413, Lancaster**	**Pa**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Superior-Lidgerwood-Mundy Corp	1101 John Ave. Superior	Wis
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

HOISTS—*TUGGER—See WINCHES*

HOSE—*AIR—STEAM—WATER—ETC*

ACME HAMILTON MFG CORP., Adv Pg 166	**Hoods St. Trenton 3**	**NJ**
Aeroquip Corp	300 S East Ave. Jackson	Mich
Aeroquip Corp. Western Div	3015 Winona Ave. Burbank	Cal
Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
AMERICAN BILTRITE RUBBER CO. BOSTON WOVEN HOSE & RUBBER DIV., Adv Pg 128	**Boston 3**	**Mass**
American Rubber Mfg Co	1145 Park Ave. Oakland 8	Cal
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Cincinnati Rubber Mfg Co Div, Thor Power Tool Co	Cincinnati 12	Ohio
Continental Rubber Works	1939 Liberty St. Erie	Pa
DAYCO CORP. DAYTON INDUSTRIAL PRODUCTS CO. DIV., Adv Pg 298	**2001 Jasion Ave. Holmco Park**	**Ill**
Eastman-Pacific Co	5240 Alhambra Ave. Los Angeles 32	Cal
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
FLEXAUST CO., Adv Pg 346	**100 Park Ave. New York 17**	**NY**
Flexible Tubing Co	Guilford	Conn
Gates Rubber Co	99 S Broadway, Denver 17	Colo
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Gray & Co, Inc	60-11 Ave. NE, Minneapolis 13	Minn
Homelite, Div of Textron Inc	75 Riverdale Ave. Port Chester	NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Lincoln Engineering Co. Div. McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Mercer Rubber Co	136 Mercer St. Trenton 90	NJ
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Parker-Hannifin Corp	17325 Euclid Ave. Cleveland 12	Ohio
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**
Republic Rubber Div. Lee Rubber & Tire Corp	Albert St. Youngstown	Ohio
Shepard Niles Crane & Hoist Corp	Schuyler Ave. Montour Falls	NY
Stratoflex Inc	Box 10398, Fort Worth	Tex
Thermoid Div. H. K. Porter Co, Inc	Whitehead Rd. Trenton 6	NJ
U S Rubber Co. Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
Yale & Towne Mfg Co. Yale Materials Handling Div	11000 Roosevelt Blvd. Philadelphia 15	Pa

HOSE FITTINGS—CLAMPS—*COUPLINGS—SWIVEL JOINTS—ETC*

Aeroquip Corp	300 S East Ave. Jackson	Mich
Aeroquip Corp. Western Div	3015 Winona Ave. Burbank	Cal
Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
American Rubber Mfg Co	1145 Park Ave. Oakland 8	Cal
Anchor Coupling Co. Inc	342 N Fourth St. Libertyville	Ill
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Chase Brass & Copper Co	236 Grand St. Waterbury 20	Conn
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Cincinnati Rubber Mfg Co Div, Thor Power Tool Co	Cincinnati 12	Ohio
Continental Rubber Works	1939 Liberty St. Erie	Pa
Dill Mfg Co	700 E 82 St. Cleveland 3	Ohio
Dixon Valve & Coupling Co	Philadelphia 22	Pa
Eastman-Pacific Co	5240 Alhambra Ave. Los Angeles 32	Cal
Flexible Tubing Co	Guilford	Conn
Gates Rubber Co	999 S Broadway, Denver 17	Colo
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
Gray & Co, Inc	60-11 Ave. NE, Minneapolis 13	Minn
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Homelite, Div of Textron Inc	75 Riverdale Ave. Port Chester	NY
Hose Accessories Co	17 St. & Lehigh Ave. Philadelphia 32	Pa
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Knox Mfg Co	222 W Clinton Ave. Oaklyn	NJ
Lunkenheimer Co	Beekman St. & Waverly Ave. Cinc 14	Ohio
Megator Corp	930 Manchester Ave. Pittsburgh 12	Pa
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
OPW-Jordan	6013 Wiehe Rd. Cincinnati 13	Ohio
Owatonna Tool Co	655 Cedar St. Owatonna	Minn
Parker-Hannifin Corp	17325 Euclid Ave. Cleveland 12	Ohio
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**
Stratoflex Inc	Box 10398, Fort Worth	Tex
Thermoid Div. H. K. Porter Co, Inc	Whitehead Rd. Trenton 6	NJ
U S Rubber Co. Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
VICTAULIC CO OF AMERICA, Adv Pg 334	**P O Box 5091E, Elizabeth**	**NJ**

HUBS—*AUTO WHEEL—SELECTIVE DRIVE*

WARN MFG CO., Adv Pg 364	**Box 6064, Riverton Branch, Seattle 88**	**Wash**

HYDRAULIC CYLINDERS—*See CYLINDERS—AIR & HYDRAULIC*

HYDRAULIC MONITOR—*See MONITORS*

HYDRAULIC MOTORS

American Brake Shoe Co	530 Fifth Ave. New York 36	NY
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave. Youngstown	Ohio
Dilgear Co	1560 W Pierce St. Milwaukee 4	Wis
Rockwell Mfg Co	400 N Lexington Ave. Pittsburgh 8	Pa
Vickers Inc	Administrative & Eng Center, Detroit 32	Mich
The Weatherhead Co	300 E 131st St. Cleveland 8	Ohio

HYDRAULIC PUMPS—*See PUMPS—HYDRAULIC FLUID*

HYDRAULIC RAMS—*See PUMPS—HYDRAULIC RAM*

HYDROMETER *See METERS—LIQUID DENSITY*

INSTRUMENTS—*See DRAFTING EQUIPMENT: GEOPHYSICAL INSTRUMENTS: CHEMICAL LABORATORY EQUIPMENT: LABORATORY & SCIENTIFIC INSTRUMENTS—EQUIPMENT & SUPPLIES: METERS: SURVEYING EQUIPMENT*

INSULATING MATERIALS—*ELECTRICAL*

Continental-Diamond Fibre Corp, Sub. Budd Co	Newark	Del
COORS PORCELAIN CO., Adv Pg 138	**600 Ninth St. Golden**	**Colo**
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Dow Corning Corp	Midland	Mich
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2446 Nemours Bldg. Wilmington**	**Del**
Esso Standard Div. Humble Oil & Refining Co	15 W 51 St. New York 19	NY
General Cable Corp	730 Third Ave. New York 17	NY
Keasbey & Mattison Co	Ambler	Pa
Minnesota Mining & Mfg Co	900 Bush Ave. St Paul 6	Minn
Ruberoid Co	500 Fifth Ave. New York 36	NY
The Russell Mfg Co	Middletown	Conn
Sherwin-Williams Co	101 Prospect Ave. NW, Cleveland 1	Ohio
Synthane Corp	River Rd. Oaks	Pa
Taylor Fibre Co	Norristown	Pa
WESTINGHOUSE ELECTRIC CORP Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

INSULATING MATERIALS—*MOISTURE & GAS*

Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**

Gustin-Bacon Mfg Co ..... 210 W 10 St, Kansas City ..... Mo
Pittsburgh Corning Corp ..... 1 Gateway Center, Pittsburgh 22 ..... Pa

INSULATING MATERIALS–*SOUND*

Canadian Industries, Ltd ..... Box 10, Montreal ..... Can
Eagle - Picher Co ..... American Bldg, Cincinnati 1 ..... Ohio
Gustin-Bacon Mfg Co ..... 210 W 10 St, Kansas City ..... Mo
Johns-Manville ..... 22 E 40 St, New York 16 ..... NY
Keasbey & Mattison Co ..... Ambler ..... Pa
Minnesota Mining & Mfg Co ..... 900 Bush Ave, St Paul 6 ..... Minn
Pittsburgh Corning Corp ..... 1 Gateway Center, Pittsburgh 22 ..... Pa

INSULATING MATERIALS–*THERMAL–BLOCK–Also See* REFRACTORIES

Canadian Industries, Ltd ..... Box 10, Montreal ..... Can
Carey, Philip, Mfg Co ..... 320 S Wayne Ave, Cincinnati 15 ..... Ohio
DOW CHEMICAL CO., Adv. Pgs. 152-153 ..... **Midland** ..... **Mich**
Eagle - Picher Co ..... American Bldg, Cincinnati 1 ..... Ohio
Green Fire Brick Co ..... Mexico ..... Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78–79 ..... **307 Fifth Ave, Pittsburgh 22** ..... **Pa**
Johns-Manville ..... 22 E 40 St, New York 16 ..... NY
Kaiser Aluminum & Chemical Sales ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Keasbey & Mattison Co ..... Ambler ..... Pa
Minnesota Mining & Mfg Co ..... 900 Bush Ave, St Paul 6 ..... Minn
Norton Co ..... 1 New Bond St, Worcester 6 ..... Mass
Pittsburgh Corning Corp ..... 1 Gateway Center, Pittsburgh 22 ..... Pa
H. K. Porter Co, Refractories Div ..... 601 Grant St, Pittsburgh 19 ..... Pa
Ruberoid Co ..... 500 Fifth Ave, New York 36 ..... NY

INSULATING MATERIALS–*THERMAL–BULK Also See* REFRACTORIES

Canadian Industries, Ltd ..... Box 10, Montreal ..... Can
Carey, Philip, Mfg Co ..... 320 S Wayne Ave, Cincinnati 15 ..... Ohio
Eagle - Picher Co ..... American Bldg, Cincinnati 1 ..... Ohio
Green Fire Brick Co ..... Mexico ..... Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78–79 ..... **307 Fifth Ave, Pittsburgh 22** ..... **Pa**
Johns-Manville ..... 22 E 40 St, New York 16 ..... NY
Kaiser Aluminum & Chemical Sales ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Norton Co ..... 1 New Bond St, Worcester 6 ..... Mass
H. K. Porter Co, Refractories Div ..... 601 Grant St, Pittsburgh 19 ..... Pa
Ruberoid Co ..... 500 Fifth Ave, New York 36 ..... NY

INSULATING MATERIALS–*THERMAL–CASTABLE & CEMENT COMPOUNDS–Also See* REFRACTORIES

Babcock & Wilcox Co ..... 161 E 42nd St, New York 17 ..... NY
Bigelow-Liptak Corp ..... 13300 Puritan Ave, Detroit 27 ..... Mich
Canadian Industries, Ltd ..... Box 10, Montreal ..... Can
Carey, Philip, Mfg Co ..... 320 S Wayne Ave, Cincinnati 15 ..... Ohio
Dow Corning Corp ..... Midland ..... Mich
Eagle - Picher Co ..... American Bldg, Cincinnati 1 ..... Ohio
General Chemical Div, Allied Chemical Corp ..... 40 Rector St, New York 6 ..... NY
Green Fire Brick Co ..... Mexico ..... Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78–79 ..... **307 Fifth Ave, Pittsburgh 22** ..... **Pa**
Johns-Manville ..... 22 E 40 St, New York 16 ..... NY
Kaiser Aluminum & Chemical Sales ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc ..... 300 Lakeside Dr, Oakland 12 ..... Cal
Keasbey & Mattison Co ..... Ambler ..... Pa
Minnesota Mining & Mfg Co ..... 900 Bush Ave, St Paul 6 ..... Minn
Norton Co ..... 1 New Bond St, Worcester 6 ..... Mass
H. K. Porter Co, Refractories Div ..... 601 Grant St, Pittsburgh 19 ..... Pa
Robinson Clay Product Co ..... 65 W State St, Akron 9 ..... Ohio

INSULATING MATERIALS–*THERMAL–CLOTH & PAPER*

Canadian Industries, Ltd ..... Box 10, Montreal ..... Can
Carey, Philip, Mfg Co ..... 320 S Wayne Ave, Cincinnati 15 ..... Ohio
Johns-Manville ..... 22 E 40 St, New York 16 ..... NY
Keasbey & Mattison Co ..... Ambler ..... Pa
Minnesota Mining & Mfg Co ..... 900 Bush Ave, St Paul 6 ..... Minn
The Russell Mfg Co ..... Middletown ..... Conn
Scott Williams Mineral Co, Inc ..... 440 N Scottsdale Rd, Scottsdale ..... Ariz

ION EXCHANGE EQUIPMENT *(SPECIAL)–DOES NOT INCLUDE STANDARD AUXILIARY EQUIPMENT; Also See* WATER CLARIFICATION

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56–57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Chemical Separations Corp ..... Box 1031, Oak Ridge ..... Tenn
Cochrane Div, Crane Co ..... 17th St, below Allegheny Ave, Phila 32 ..... Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
Graver Water Conditioning Co, Union Tank Car Co, Div ..... 216 W 14 St, New York 11 ..... NY
Infilco, Inc ..... 901 S Campbell Ave, Tucson ..... Ariz
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
Ledoux & Co, Inc ..... 359 Alfred Ave, Teaneck ..... NJ
Permutit Co, Div, Pfaudler Permutit Inc ..... 50 W 44 St, New York 36 ..... NY
STEARNS ROGER MFG CO., Adv Pg 291 ..... **660 Bannock St, Denver 17** ..... **Colo**

ION EXCHANGE RESINS

J. T. Baker Chemical Co ..... Phillipsburg ..... NJ
DOW CHEMICAL CO., Adv. Pgs. 152-153 ..... **Midland** ..... **Mich**
Ionac Chemical Co, Div, Pfaudler Permutit Inc ..... Birmingham ..... NJ
Nalco Chemical Co ..... 6216 W 66th Pl, Chicago 39 Ill
Permutit Co, Div, Pfaudler Permutit Inc ..... 50 W 44 St, New York 36 ..... NY
Rohm & Haas Co ..... 222 W Washington Sq, Philadelphia 5 ..... Pa

JACKS–*LIFTING (SCREW–HYDRAULIC–ETC.)–Also See* HOISTS; JACKS–*ROOF*

Caster Mold & Machine Co ..... 1079 E & J St, Barberton ..... Ohio
Cleveland Worm & Gear Div, Eaton Mfg Co ..... 3300 E 80th St, Cleveland 4 ..... Ohio
Duff Norton Co ..... 4 Gateway Center, Pittsburgh 22 ..... Pa
Foster, L. B., Co ..... Box 1647, Pittsburgh 30 ..... Pa
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
NATIONAL MINE SERVICE CO., Adv Pg 144 ..... **2530 Koppers Bldg, Pittsburgh 19** ..... **Pa**
Owatonna Tool Co ..... 655 Cedar St, Owatonna ..... Minn
The Rockwin Co, Ltd ..... P O Box 1089, Sudbury ..... Ont
Ryerson & Son, Inc ..... 8000A, Chicago 80 Ill
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

JACKS–*PULLING–See* HOISTS

JACKS–*ROOF–Also See* MINE SUPPORTS–*RE-USABLE PROPS*

Acrow Corp of America ..... 231 Washington Ave, Carlstadt ..... NJ
Duff Norton Co ..... 4 Gateway Center, Pittsburgh 22 ..... Pa
Foster, L. B., Co ..... Box 1647, Pittsburgh 30 ..... Pa
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
NATIONAL MINE SERVICE CO., Adv Pg 144 ..... **2530 Koppers Bldg, Pittsburgh 19** ..... **Pa**
The Rockwin Co, Ltd ..... P O Box 1089, Sudbury ..... Ont
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

JIGS–See SEPARATORS–*JIG*

KILN (& INDUSTRIAL) GUNS (DECLOGGING)–*DOES NOT INCLUDE REFRACTORY PLACERS*

Long-Airdox Co, Marmon-Herrington Inc ..... P O Box 331, Oak Hill ..... W Va
Remington Arms Co, Inc ..... 939 Barnum Ave, Bridgeport 2 ..... Conn

KILNS–*ROASTERS & DRYERS–See BELOW; Also See* DRYERS; FURNACES; RETORTS; SINTERING EQUIPMENT

KILNS–*ROASTERS & DRYERS–BEEHIVE–TUNNEL & SINGLE HEARTH (STATIONARY & MOVING)*

Denver Fire Clay Co ..... 3033 Blake St, Denver 17 ..... Colo
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
Hevi-Duty Electric Co ..... 304 Hart St, Watertown ..... Wis
Surface Combustion Div, Midland-Ross Corp ..... 2375 Dorr St, Toledo 1 ..... Ohio

KILNS–*ROASTERS & DRYERS–MULTIPLE-HEARTH (MECHANICAL RABBLE) TOWER*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56–57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Electric Steel Foundry Co ..... 214 NW 25 Ave, Portland 10 ..... Ore
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
Hevi-Duty Electric Co ..... 304 Hart St, Watertown ..... Wis
Nichols Engineering & Research Corp ..... 80 Pine St, New York 5 ..... NY
NORDBERG MFG CO., Adv. Pgs. 306–307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**
Pacific Foundry & Metallurgy Co ..... 3100 Nineteenth St, San Francisco 10 ..... Cal

KILNS–*ROASTERS & DRYERS–ROTARY*

Alco Products Inc ..... Dept. 915, Schenectady 5 ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56–57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
BETHLEHEM STEEL CO., Adv Pg 46 ..... **Bethlehem** ..... **Pa**
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
Electric Steel Foundry Co ..... 214 NW 25 Ave, Portland 10 ..... Ore
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
Gould Gordon L, Co ..... 58 Sutter St, San Francisco 4 ..... Cal
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
HARDINGE CO, INC., Adv. Pgs. 340–341 ..... **240 Arch St, York** ..... **Pa**
Hevi-Duty Electric Co ..... 304 Hart St, Watertown ..... Wis
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
Link-Belt Co, Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... **307 W Third St, Pittsburg** ..... **Kan**
Pacific Foundry & Metallurgy Co ..... 3100 Nineteenth St, San Francisco 10 ..... Cal
SMIDTH, F. L. & CO., Adv Pg 141 ..... **Rockefeller Center, New York 20** ..... **NY**
Standard Steel Corp ..... 5060 Boyle Ave, Los Angeles 58 ..... Cal
STEARNS ROGER MFG CO., Adv Pg 291 ..... **660 Bannock St, Denver 17** ..... **Colo**
Surface Combustion Div, Midland-Ross Corp ..... 2375 Dorr St, Toledo 1 ..... Ohio
TAYLOR ENGINEERING & MFG. DIV OF FULLER CO., Adv. Pgs. 25, 26–27, 28 ..... **Mill St, Allentown** ..... **Pa**
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo

KILNS–*ROASTERS & DRYERS–SHAFT–See* FURNACES–*SHAFTS*

LABORATORY & SCIENTIFIC INSTRUMENTS–*EQUIPMENT & SUPPLIES OTHER THAN CHEMICALS–CHEMICAL LAB. EQUIP.–GEOPHYSICAL INSTRUMENTS–DRAFTING EQUIPMENT–SURVEYING EQUIPMENT–Also See* METERS

AINSWORTH, WILLIAM, & SONS, Adv Pg 347 ..... **2151 Lawrence St, Denver 5** ..... **Colo**
American Optical Co, Safety Products Div ..... 98 Mechanic St, Southbridge ..... Mass
Bausch & Lomb Inc ..... 83761 Bausch St, Rochester 2 ..... NY
Beckman Instruments, Inc, Scientific & Process Instruments Div ..... 2500 Harbor Blvd, Fullerton ..... Cal
Beco, Inc ..... Box 3086, Glencoe Sta, Burbank ..... Cal
BOULDER SCIENTIFIC, Adv Pg 375 ..... **250 Pearl St, Boulder** ..... **Colo**
Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
Cahn Instrument Corp ..... 14511 Paramount Blvd, Paramount ..... Cal
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
Curtiss-Wright Corp ..... Box 110, Princeton ..... NJ
Daystrom, Inc, Weston Instruments Div ..... 614 Frelinghuysen Ave, Newark ..... NJ
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Denver Fire Clay Co ..... 3033 Blake St, Denver 17 ..... Colo
Engelhard Industries, Inc ..... 113 Astor St, Newark ..... NJ
Esterline Angus Instrument Co, Inc ..... Box 596, Indianapolis 6 ..... Ind
Fisher Scientific Co ..... 717 Forbes Ave, Pittsburgh 19 ..... Pa
Gallgher Co ..... Box 209, Salt Lake City 10 ..... Utah
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Geo-Optic & Paper Corp ..... 149 Church St, New York 7 ..... NY
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Gilson Screen Co ..... 110 Center St, Malinta ..... Ohio
Heys Corp ..... 742 E 8 St, Michigan City ..... Ind
Heinrichs Geoexploration Co ..... P O Box 5671, Tucson ..... Ariz
Hevi-Duty Electric Co ..... 304 Hart St, Watertown ..... Wis
Kem Instruments, Inc ..... P O Box 727, White Plains ..... NY
Laboratory Equipment Corp ..... Lakeview & Hilltop, St Joseph ..... Mich
Leeds & Northrup Co ..... 4970 Stenton Ave, Philadelphia 44 ..... Pa
Magnaflux Corp ..... 7328 W Lawrence Ave, Chicago 31 Ill
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322–323 ..... **Box 9541, Denver 16** ..... **Colo**
MIXING EQUIPMENT CO., Adv Pg 135 ..... **234 Mt Read Blvd, Rochester 3** ..... **NY**
Moran Instrument Corp ..... 170 E Orange Grove Ave, Pasadena 3 ..... Cal
Morse Bros Machinery Co ..... 2900 Brighton Blvd, Denver ..... Colo
Motorola Communications & Electronics Inc ..... 4501 Augusta Blvd, Chicago 51 Ill
Norton Co ..... 1 New Bond St, Worcester 6 ..... Mass
Philips Electronic Instruments ..... 750 S Fulton Ave, Mt Vernon ..... NY
Frederick Post Co ..... 3650 N Avondale Ave, Chicago 18 Ill
Precision Thermometer & Instrument Co ..... 1434 Brandywine St, Philadelphia 30 ..... Pa
Special Instruments Laboratory Inc ..... 312 W Vine Ave, Knoxville 2 ..... Tenn
STURTEVANT MILL CO., Adv Pg 362 ..... **101 Clayton St, Boston 22** ..... **Mass**
Taylor Instrument Cos ..... 95 Ames St, Rochester 1 ..... NY
Torsion Balance Co ..... Clifton ..... NJ
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60–61, 150–151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**
WILD HEERBRUGG INSTRUMENTS, INC., Adv Pg 299 ..... **Main & Covert Sts, Port Washington** ..... **NY**

LABORATORY SERVICE–CHEMICAL ANALYZING & ASSAYING

Arizona Testing Laboratories ..... 817 W Madison St, Phoenix ..... Ariz
BOULDER SCIENTIFIC, Adv Pg 375 ..... **250 Pearl St, Boulder** ..... **Colo**
California Testing Laboratories ..... 619 E Washington Blvd, Los Angeles 15 ..... Cal
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Dickinson Laboratories, Inc ..... P O Box 7006, El Paso ..... Tex
El Paso Testing Laboratory, Ltd ..... Box 1565, El Paso ..... Tex
Engelhard Industries, Inc ..... 113 Astor St, Newark ..... NJ
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Goodall Brothers ..... 46 S Main St, Helena ..... Mont
Hanks, Abbot A., Inc ..... 1300 Sansome St, San Francisco 11 ..... Cal
Hawley & Hawley Assayers & Chemists Inc ..... Box 1060, Douglas ..... Ariz
Heinrichs Geoexploration Co ..... P O Box 5671, Tucson ..... Ariz
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
Ledoux & Co, Inc ..... 359 Alfred Ave, Teaneck ..... NJ
Magnaflux Corp ..... 7328 W Lawrence Ave, Chicago 31 Ill
Nichols Laboratories Inc ..... 160 S West Temple, Salt Lake City 1 ..... Utah
Southwestern Engineering Co ..... 4800 Santa Fe Ave, Los Angeles 58 ..... Cal
Spectrochemical Laboratories Inc ..... 8350 Frankstown Ave, Pittsburgh 21 ..... Pa

LABORATORY SERVICE–*MINERAL DETERMINATION*

Booth Co, Inc ..... 333 W 14 S, Salt Lake City 15 ..... Utah
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Dickinson Laboratories, Inc ..... P O Box 7006, El Paso ..... Tex
El Paso Testing Laboratory, Ltd ..... Box 1565, El Paso ..... Tex
Gallgher Co ..... Box 209, Salt Lake City 10 ..... Utah
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Hawley & Hawley Assayers & Chemists Inc ..... Box 1060, Douglas ..... Ariz
Heinrichs Geoexploration Co ..... P O Box 5671, Tucson ..... Ariz
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
McDOWELL CO, INC. THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave, NE, Cleveland 14** ..... **Ohio**
Minerals Engineering Co ..... P O Box 1951, Grand Junction ..... Colo
Scott Williams Mineral Co, Inc ..... 440 N Scottsdale Rd, Scottsdale ..... Ariz
Southwestern Engineering Co ..... 4800 Santa Fe Ave, Los Angeles 58 ..... Cal
Spectrochemical Laboratories Inc ..... 8350 Frankstown Ave, Pittsburgh 21 ..... Pa
Western Machinery Co, Wenco Div ..... 650 Fifth St, San Francisco 7 ..... Cal

LABORATORY SERVICE–*TESTING OTHER THAN CHEMICAL & MINERAL ABOVE–Also See* CONSULTANTS; CONTRACTORS

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56–57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Arizona Testing Laboratories ..... 817 W Madison St, Phoenix ..... Ariz
California Testing Laboratories ..... 619 E Washington Blvd, Los Angeles 15 ..... Cal
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
Chemical Separations Corp ..... Box 1031, Oak Ridge ..... Tenn
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Dickinson Laboratories, Inc ..... P O Box 7006, El Paso ..... Tex
El Paso Testing Laboratory, Ltd ..... Box 1565, El Paso ..... Tex
Gallgher Co ..... Box 209, Salt Lake City 10 ..... Utah
Geodynamics, Inc ..... Box 1258, 1543 3rd St, Santa Monica ..... Cal
Heinrichs Geoexploration Co ..... P O Box 5671, Tucson ..... Ariz
Ionics Inc ..... 152 Sixth St, Cambridge 42 ..... Mass
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
Ledoux & Co, Inc ..... 359 Alfred Ave, Teaneck ..... NJ
Magnaflux Corp ..... 7328 W Lawrence Ave, Chicago 31 Ill
Nichols Engineering & Research Corp ..... 80 Pine St, New York 5 ..... NY
Southwestern Engineering Co ..... 4800 Santa Fe Ave, Los Angeles 58 ..... Cal
Spectrochemical Laboratories Inc ..... 8350 Frankstown Ave, Pittsburgh 21 ..... Pa
STURTEVANT MILL CO., Adv Pg 362 ..... **101 Clayton St, Boston 22** ..... **Mass**

LIGHTING FIXTURES & LAMPS–*INDUSTRIAL (ELECTRIC)–Also See FLOOD LIGHTS*

Day-Ray Products, Inc ..... 1133 Mission St, South Pasadena ..... Cal
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
JOY MANUFACTURING CO., Adv. Pgs. 70–71 ..... **333 Henry W Oliver Bldg, Pittsburgh 22** ..... **Pa**
Line Material Industries, McGraw-Edison Co ..... 700 W Michigan St, Milwaukee 1 ..... Wis
Phoenix Products Co ..... 4715 N 27 St, Milwaukee ..... Wis
Ray-O-Vac Co ..... 212 E Washington Ave, Madison 10 ..... Wis
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60–61, 150–151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

LININGS & CLADDINGS–See BELOW; Also See FURNACE LININGS; INSULATING MATERIALS; STEEL–ALLOY; TANKS–LINED; DOES NOT INCLUDE COATINGS

LININGS & CLADDINGS–ABRASION RESISTANT–METALLIC–See STEEL–ALLOY; DOES NOT INCLUDE COATINGS

LININGS & CLADDINGS–ABRASION–RESISTANT–NON-METALLIC

Amercoat Corp	4809 Firestone Blvd. South Gate	Cal
Carboline Co	32 Hanley Ind. Ct. St Louis 17	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2466 Nemours Bldg. Wilmington**	**Del**
Galigher Co	Box 209, Salt Lake City 10	Utah
Gates Engineering Co	100 S West St. Wilmington 99	Del
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
LIMATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Norton Co	1 New Bond St. Worcester 6	Mass
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**

LININGS & CLADDINGS–CORROSION-RESISTANT METALLIC–Also See STEEL–ALLOY; TANKS–LINED–DOES NOT INCLUDE COATINGS

Babcock & Wilcox Co	161 E 42nd St. New York 17	NY
Canadian Industries, Ltd	Box 10, Montreal	Can
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hauser-Stander Tank Co	4820 Spring Grove Ave, Cincinnati 32	Ohio
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Ionics Inc	152 Sixth St. Cambridge 42	Mass
MEEHANITE METAL CORP., Adv Pg 337	**714 North Ave. New Rochelle**	**NY**

LININGS & CLADDINGS–CORROSION-RESISTANT–NON-METALLIC–Also See TANKS–LINED–DOES NOT INCLUDE COATINGS

Amercoat Corp	4809 Firestone Blvd. South Gate	Cal
Canadian Industries, Ltd	Box 10, Montreal	Can
Carboline Co	32 Hanley Ind. Ct. St Louis 17	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2466 Nemours Bldg. Wilmington**	**Del**
Galigher Co	Box 209, Salt Lake City 10	Utah
Garlock Inc	402 E Main St. Palmyra	NY
Gates Engineering Co	100 S West St. Wilmington 99	Del
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Hauser-Stander Tank Co	4820 Spring Grove Ave, Cincinnati 32	Ohio
Luzerne Rubber Co	Muirhead & Dewey Sts. Trenton 7	NJ
Mercer Rubber Co	136 Mercer St. Trenton 90	NJ
National Carbon Co, Union Carbide Corp	270 Park Ave. New York 17	NY
Norton Co	1 New Bond St. Worcester 6	Mass
RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83	**42 Townsend St. Passaic**	**NJ**

LOADERS–See BELOW; Also See CONVEYORS; DREDGES; EXCAVATORS; SCRAPERS; TRUCKS & TRAILERS SELF-LOADING

LOADERS–BOXCAR

Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Hough, Frank G., Co	726 Seventh St. Libertyville	Ill
Link-Belt Co. Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave. Aurora**	**Ill**

LOADERS–FRONT-END SCOOP–CRAWLER-TRACTOR–DOES NOT INCLUDE OVERCAST TYPE

Allis Chalmers Mfg Co, Construction Machinery Div	1126 S 70 St. Milwaukee	Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318	**Peoria**	**Ill**
Case, J. I., Co, Industrial Div	700 State St. Racine	Wis
John Deere	3300 River Dr. Moline	Ill
Drott Mfg Corp	3126 S 27 St. Milwaukee 15	Wis
EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Hough, Frank G., Co	726 Seventh St. Libertyville	Ill
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Oliver Corp	400 W Madison, Chicago 6	Ill

LOADERS–FRONT-END SCOOP–WHEELED TRACTOR–DOES NOT INCLUDE OVERCAST TYPE

Allis Chalmers Mfg Co, Construction Machinery Div	1126 S 70 St. Milwaukee	Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318	**Peoria**	**Ill**
Case, J. I., Co, Industrial Div	700 State St. Racine	Wis
Clark Equipment Co, Construction Machinery Div	Box 599, Pipestone Rd. Benton Harbor	Mich
John Deere	3300 River Dr. Moline	Ill
Hough, Frank G., Co	726 Seventh St. Libertyville	Ill
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Oliver Corp	400 W Madison, Chicago 6	Ill
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill
Thew Shovel Co	Lorain	Ohio

LOADERS–GATHERING-HEAD–MINE–TYPE–Also See LOADERS–SELF-LOADING CONVEYOR

GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Goodman Mfg Co	Halsted St. & 48th Pl. Chicago 9	Ill
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70–71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Long-Airdox Co, Marmon-Herrington Inc	P O Box 331, Oak Hill	W Va
Myers-Whaley Co, Inc	Box 789, Knoxville 1	Tenn

LOADERS–OVERCASTING BUCKET–MINE–TYPE–CRAWLER–RAIL & WHEELED

EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**

LOADERS–SCRAPER-SLUSHER MOVABLE RAMP

JOY MANUFACTURING CO., Adv. Pgs. 70–71	**333 Henry W Oliver Bldg. Pittsburgh 22**	**Pa**
Parts, Inc	949 W Qunyle Ave. Salt Lake City 4	Utah
Rogers Iron Works Co	Joplin	Mo
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

LOADERS–SELF-LOADING CONVEYOR–(CHAIN–BELT–BUCKET-LINE–ETC.) WITH DIGGING COMPONENT–DOES NOT INCLUDE EXCAVATORS OR CONVEYOR ALONE. Also See LOADERS–GATHERING-HEAD–MINE–TYPE

ATHEY PRODUCTS CORP., Adv Pg 171	**5631 W 65 St. Chicago 38**	**Ill**
Bonded Scale & Machine Co	38 Bellevue Ave, Columbus 7	Ohio
EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Goodman Mfg Co	Halsted St. & 48th Pl. Chicago 9	Ill
Hewitt-Robins, Inc	666 Glenbrook Rd. Stamford	Conn
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
MACHINERY CENTER INC., Adv Pg 355	**Box 964, 1201 S 6 St. Salt Lake City 10**	**Utah**
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill

LOADERS–SPECIAL MINE SHAFT MUCKING

Coeur D'Alenes Co	Wallace	Idaho
EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
GARDNER DENVER CO., Adv. Pgs. 142–143	**Gardner Expwy. Quincy**	**Ill**
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
SHAFT & DEVELOPMENT MACHINES INC., Adv Pg 355	**808 Newhouse Bldg. Salt Lake City 11**	**Utah**

LOADERS–SPECIAL TUNNEL MUCKING–Also See TRUCKS & TRAILERS–SPECIAL SELF-LOADING

Coeur D'Alenes Co	Wallace	Idaho
EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Goodman Mfg Co	Halsted St. & 48th Pl. Chicago 9	Ill
Lake Shore Inc	P O Box 911, Iron Mountain	Mich
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Myers-Whaley Co, Inc	Box 789, Knoxville 1	Tenn
Sanford-Day Corp	Dale Ave. Knoxville 9	Tenn

LOADING ACCESSORIES

G. R. Johnson Loading Supplies	9027 Butterworth Rd. Mercer Island	Wash

LOADING ATTACHMENTS–SPECIAL FOR SELF-LOADING VEHICLES

Carboline Co	32 Hanley Ind. Ct. St Louis 17	Mo
CATERPILLAR TRACTOR CO., Adv. Pgs. 36–37, 44, 318	**Peoria**	**Ill**
Case, J. I., Co, Industrial Div	700 State St. Racine	Wis

LOADING BOOMS–See CONVEYORS; CRANES

LOCOMOTIVES–COMPRESSED AIR

EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
FATE-ROOT-HEATH CO., Adv Pg 132	**Plymouth**	**Ohio**
Frank, M. K.	480 Lexington Ave. New York 17	NY
Hack Engineering Co	124 Wazee Market, Denver	Colo
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo

LOCOMOTIVES–ELECTRIC BATTERY & TROLLEY

Atlas Car & Mfg Co	1100 Ivanhoe Rd. Cleveland 10	Ohio
DIFFERENTIAL CO., Adv Pg 350	**Findlay**	**Ohio**
Differential Steel Car Co	Findlay	Ohio
FATE-ROOT-HEATH CO., Adv Pg 132	**Plymouth**	**Ohio**
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Goodman Mfg Co	Halsted St. & 48th Pl. Chicago 9	Ill
Ironton Engine Co	Paynters Rd. Farmingdale	NJ
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
Kersey Mfg Co, Inc	Box 151, Bluefield	Va
Mancha Storage Battery Locomotive Div Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**

LOCOMOTIVES–GASOLINE–DIESEL & DIESEL–ELECTRIC

Alco Products Inc	Dept. 915, Schenectady 5	NY
Brookville Locomotive Works	Steel Blvd. Brookville	Pa
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
FATE-ROOT-HEATH CO., Adv Pg 132	**Plymouth**	**Ohio**
Frank, M. K.	480 Lexington Ave. New York 17	NY
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Hack Engineering Co	124 Wazee Market, Denver	Colo
Mancha Storage Battery Locomotive Div, Goodman Mfg Co	Halsted St. & 48 Pl. Chicago 9	Ill
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
Plymouth Locomotive Works Div of The Fate-Root-Heath Co	Plymouth	Ohio
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo

LUBRICANTS

Alemite Div, Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
Alpha Molykote Corp	65 Harvard St. Stanford	Conn
American Chain & Cable Co, American Cable Div	Wilkes-Barre	Pa
Atlantic Refining Co	260 S Broad St. Philadelphia	Pa
Climax Molybdenum Co	1270 Ave. of the Americas, New York 20	NY
Esso Standard Div. Humble Oil & Refining Co	15 W 51 St. New York 19	NY
Fiske Bros Refining Co, Lubriplate Div	129 Lockwood St. Newark 5	NJ
Gulf Oil Corp, Dept. DM	Box 2140, Houston 1	Tex
Hulburt Oil & Grease Co	Trenton & Castor Aves, Phila 34	Pa
Jet-Lube, Inc	P O Box 3126, Burbank	Cal
Keystone Lubricating Co	21 & Clearfield Sts, Philadelphia 32	Pa
Marvel Oil Co, Inc	331 N Main St. Port Chester	NY
Ohio Brass Co	Mansfield	Ohio
Ohio Oil Co	539 S Main St. Findlay	Ohio
SHELL OIL CO., Adv Pg 170	**50 W 50th St. New York 20**	**NY**
STANDARD OIL CO OF CALIFORNIA, WESTERN OPERATIONS INC., Adv Pg 25	**225 Bush St. San Francisco 20**	**Cal**
Sun Oil Co	1608 Walnut St. Philadelphia 3	Pa
TEXACO INC., Adv Pg 119	**135 E 42 St. New York 17**	**NY**
Tidewater Oil Co	660 Madison Ave. New York 21	NY
Whitmore Mfg Co	Box 1640, Sta C, Cleveland 4	Ohio

LUBRICATING EQUIPMENT

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy, Chicago 14	Ill
Dravo Corp	Neville Island, Pittsburgh 25	Pa
Farval Div. Eaton Mfg Co	3300 E 80 St. Cleveland 4	Ohio
Gray & Co, Inc	60–11 Ave. NE, Minneapolis 13	Minn
Hulburt Oil & Grease Co	Trenton & Castor Aves, Phila 34	Pa
Lincoln Engineering Co, Div, McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Lunkenheimer Co	Beekman St. & Waverly Ave. Cinc 14	Ohio
NORDBERG MFG CO., Adv. Pgs. 306–307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**
Ohio Brass Co	Mansfield	Ohio
Manzel Div, Houdaille Industries Inc	315 Babcock St. Buffalo 10	NY

MAGNETS–Also See SEPARATORS–MAGNETIC; HEAVY MEDIA RECOVERY UNITS

Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343	**P O Box 88, Pittsburgh 30**	**Pa**
Cutler-Hammer, Inc	237 N 12 St. Milwaukee 1	Wis
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352	**4716 W Electric Ave. Milwaukee 46**	**Wis**
ERIEZ MFG CO., Adv Pg 365	**315 Magnet Dr. Erie**	**Pa**
Magnetic Engineering & Mfg Co	852 Van Houten Ave, Clifton	NJ
Stackpole Carbon Co	St Marys	Pa
STEARNS MAGNETIC PRODUCTS, DIV OF INDIANA GENERAL CORP., Adv Pg 156	**635 S 28 St. Milwaukee 46**	**Wis**

MAPS–GEOGRAPHIC–DOES NOT INCLUDE CONTRACTORS–MAPPING

Abrams Aerial Survey Corp	606 Shawassee St. Lansing	Mich
American Air Surveys, Inc	907 Penn Ave, Pittsburgh 22	Pa
Ammann, Jack, Inc. Engineers & Surveyors	931 Broadway, San Antonio	Tex
HARDINGE CO. INC., Adv. Pgs. 340–341	**240 Arch St. York**	**Pa**

METALLIZING EQUIPMENT

Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Metco Inc	1101 Prospect Ave, Westbury	NY
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Rexarc Inc, Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio

METALLIZING SUPPLIES–Also See WELDING SUPPLIES; HARDFACING ALLOYS

American Chain & Cable Co, Page Steel & Wire Div	Monessen	Pa
Belmont Smelting & Refining Works	330 Belmont Ave, Brooklyn 7	NY
Eutectic Welding Alloys Corp	40–40 172 St. Flushing 58	NY
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Metco Inc	1101 Prospect Ave, Westbury	NY
Minnesota Mining & Mfg Co	900 Bush Ave, St Paul 6	Minn
Rexarc Inc, Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio
STOODY CO., Adv Pg 314	**Box 901, Whittier**	**Cal**

METERS & GAGES–ETC.–CHEMICAL (PH POLAROGRAPH–ETC.) Also See SPECTROGRAPHIC INSTRUMENTS

Analytical Measurements, Inc	585 Main St. Chatham	NJ
Bailey Meter Co	1050 Ivanhoe Rd. Cleveland	Ohio
Beckman Instruments, Inc, Scientific & Process Instruments Div	2500 Harbor Blvd. Fullerton	Cal
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Fisher Scientific Co	717 Forbes Ave, Pittsburgh 19	Pa
Hays Corp	742 E 8 St. Michigan City	Ind
Leeds & Northrup Co	4970 Stenton Ave, Philadelphia 44	Pa
Minneapolis-Honeywell Regulator, Brown Instrument Div	Wayne & Windrim Ave, Philadelphia 44	Pa
Rockwell Mfg Co	400 N Lexington Ave, Pittsburgh 8	Pa
Special Instruments Laboratory Inc	312 W Vine Ave, Knoxville 2	Tenn
Taylor Instrument Cos	95 Ames St, Rochester 1	NY

METERS & GAGES–ETC.–COUNTING

GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo

METERS & GAGES–ETC.–ELECTRICITY (AMMETERS–VOLTMETERS–ETAL)

Beckman Instruments, Inc. Scientific & Process Instruments Div	2500 Harbor Blvd, Fullerton	Cal
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Daystrom, Inc. Weston Instruments Div	614 Frelinghuysen Ave, Newark	NJ
Esterline Angus Instrument Co, Inc	Box 596, Indianapolis 6	Ind
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 304	**Schenectady 5**	**NY**
Hays Corp	742 E 8 St. Michigan City	Ind
Motorola Communications & Electronics Inc	4501 Augusta Blvd. Chicago 51	Ill
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60–61, 150–151	**Box 2278, Pittsburgh 30**	**Pa**

METERS & GAGES–ETC.–FLUID (FLOW–PRESSURE & VACUUM)

Bailey Meter Co	1050 Ivanhoe Rd, Cleveland	Ohio
Crosby Valve & Gage Co	43 Kendrick St, Wrentham	Mass
Dietz, Henry G. Co, Inc	12–16 Astoria Blvd, Long Island City 2	NY

Esterline Angus Instrument Co, Inc ..... Box 596, Indianapolis 6 ..... Ind
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Gray & Co, Inc ..... 60-11 Ave, NE, Minneapolis 13 ..... Minn
HALLIBURTON CO., Adv Pg 123 ..... **Denver 1431, Duncan** ..... **Okla**
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Infilco, Inc ..... 901 S Campbell Ave, Tucson ..... Ariz
Megator Corp ..... 930 Machester Ave, Pittsburgh 12 ..... Pa
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
Owatonna Tool Co ..... 655 Cedar St, Owatonna ..... Minn
Precision Thermometer & Instrument Co ..... 1434 Brandywine St, Philadelphia 30 ..... Pa
Rockwell Mfg Co ..... 400 N Lexington Ave, Pittsburgh 8 ..... Pa
Taylor Instrument Cos ..... 95 Ames St, Rochester 1 ..... NY
U S Gauge Div, American Machine & Metals ..... Sellersville ..... Pa
Vapor Recovery Systems Co ..... 2820 N Alameda St, Compton ..... Cal
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

METERS & GAGES–*HARDNESS TESTING*

Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Magnaflux Corp ..... 7328 W Lawrence Ave, Chicago 31 Ill
U S Gauge Div, American Machine & Metals ..... Sellersville ..... Pa

METERS & GAGES–*INDICATING & MEASURING DEVICES & INSTRUMENTS (REMOTE-RECORDING-ETC.)–See BELOW: Also See* BIN-LEVEL INDICATORS; COMMUNICATIONS; CONTROLS; DRAFTING INSTRUMENTS; GAS (& MOISTURE) DETECTORS; GEOPHYSICAL INSTRUMENTS; CHEMICAL LABORATORY EQUIPMENT; LABORATORY & SCIENTIFIC INSTRUMENTS; SCALES; SURVEYING INSTRUMENTS; SPECTROSCOPIC INSTRUMENTS

AGA Corp of America ..... P O Box 447, South Plainfield ..... NJ
Aerotec Industries, Inc ..... Greenwich ..... Conn
American Optical Co, Safety Products Div ..... 98 Mechanic St, Southbridge ..... Mass
American Paulin System ..... 1524 S Flower St, Los Angeles 15 ..... Cal
Analytical Measurements, Inc ..... 585 Main St, Chatham ..... NJ
B-I-F Industries, Inc ..... 345 Harris Ave, Providence 1 ..... RI
Bailey Meter Co ..... 1050 Ivanhoe Rd, Cleveland ..... Ohio
Crosby Valve & Gage Co ..... 43 Kendrick St, Wrentham ..... Mass
Curtiss-Wright Corp ..... Box 110, Princeton ..... NJ
Daystrom, Inc, Weston Instruments Div ..... 614 Frelinghuysen Ave, Newark ..... NJ
Dietz, Henry G, Co, Inc ..... 12-16 Astoria Blvd, Long Island City 2 ..... NY
Dyna Metric, Inc ..... 2955 E Colorado Blvd, Pasadena ..... Cal
Erie Strayer Co ..... Erie ..... Pa
Esterline Angus Instrument Co, Inc ..... Box 596, Indianapolis 6 ..... Ind
Exploration Methods, Inc ..... Box 100, Ishpeming ..... Mich
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Geo-Optic & Paper Corp ..... 149 Church St, New York 7 ..... NY
Goldak Co, Inc ..... 1544 W Glenoaks Blvd, Glendale 1 ..... Cal
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Hemmicks Geoexploration Co ..... P O Box 5671, Tucson ..... Ariz
Howe Scale Co ..... Rutland ..... Vt
Industrial Nucleonics Corp ..... 650 Ackerman Rd, Columbus 2 ..... Ohio
Laboratory Equipment Corp ..... Lakeview & Hilltop, St Joseph ..... Mich
Linde Co, Union Carbide Corp ..... 270 Park Ave, New York 17 ..... NY
Magnaflux Corp ..... 7328 W Lawrence Ave, Chicago 31 Ill
Megator Corp ..... 930 Machester Ave, Pittsburgh 12 ..... Pa
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
Philips Electronic Instruments ..... 750 S Fulton Ave, Mt Vernon ..... NY
Precision Thermometer & Instrument Co ..... 1434 Brandywine St, Philadelphia 30 ..... Pa
Rockwell Mfg Co ..... 400 N Lexington Ave, Pittsburgh 8 ..... Pa
Taylor Instrument Cos ..... 95 Ames St, Rochester 1 ..... NY
U S Gauge Div, American Machine & Metals ..... Sellersville ..... Pa
Yamall-Waring Co ..... 102 E Mermain Ln, Philadelphia 18 ..... Pa

METERS & GAGES–*ETC.–LIQUID (& SLURRY) DENSITY*

Bailey Meter Co ..... 1050 Ivanhoe Rd, Cleveland ..... Ohio
Curtiss-Wright Corp ..... Box 110, Princeton ..... NJ
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
HALLIBURTON CO., Adv Pg 123 ..... **Denver 1431, Duncan** ..... **Okla**
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Industrial Nucleonics Corp ..... 650 Ackerman Rd, Columbus 2 ..... Ohio
INDUSTRIAL PHYSICS & ELECTRONICS CO.,
Adv Pg 362 ..... **470 S 10 E, Salt Lake City 2** ..... **Utah**
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
Precision Thermometer & Instrument Co ..... 1434 Brandywine St, Philadelphia 30 ..... Pa
Rockwell Mfg Co ..... 400 N Lexington Ave, Pittsburgh 8 ..... Pa
Yamall-Waring Co ..... 102 E Mermaid Ln, Philadelphia 18 ..... Pa

METERS & GAGES–*NUCLEAR*

Nuclear Chicago Corp ..... 333 E Howard St, Des Plaines Ill

METERS & GAGES ETC.–*SPEED (TACHOMETER–ET AL)*

Bailey Meter Co ..... 1050 Ivanhoe Rd, Cleveland ..... Ohio
Daystrom, Inc, Weston Instruments Div ..... 614 Frelinghuysen Ave, Newark ..... NJ
Esterline Angus Instrument Co, Inc ..... Box 596, Indianapolis 6 ..... Ind
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Ideal Industries, Inc ..... 1020 Park Ave, Sycamore Ill
Leeds & Northrup Co ..... 4970 Stenton Ave, Philadelphia 44 ..... Pa
Metron Instrument Co ..... 432 Lincoln St, Denver ..... Colo
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
WESTINGHOUSE ELECTRIC CORP.,
Adv. Pgs. 60-61, 150-151 ..... **Box 2278, Pittsburgh 30** ..... **Pa**

METERS & GAGES–*ETC.–STRAIN–PRESSURE–WEIGHT–DOES NOT INCLUDE METERS & GAGES–FLUID (PRESSURE) METERS & GAGES–LINEAR MEASURE; SCALES*

Asea Electric, Inc ..... 500 Fifth Ave, New York 36 ..... NY
Bailey Meter Co ..... 1050 Ivanhoe Rd, Cleveland ..... Ohio
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Infilco, Inc ..... 901 S Campbell Ave, Tucson ..... Ariz
Leeds & Northrup Co ..... 4970 Stenton Ave, Philadelphia 44 ..... Pa
Megator Corp ..... 930 Machester Ave, Pittsburgh 12 ..... Pa
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
Moran Instrument Corp ..... 170 E Orange Grove Ave, Pasadena 3 ..... Cal
Owatonna Tool Co ..... 655 Cedar St, Owatonna ..... Minn
Taylor Instrument Cos ..... 95 Ames St, Rochester 1 ..... NY
U S Gauge Div, American Machine & Metals ..... Sellersville ..... Pa
Vapor Recovery Systems Co ..... 2820 N Alameda St, Compton ..... Cal
Wallace & Tiernan Inc ..... Belleville 9 ..... NJ

METERS & GAGES–*ETC.–TEMPERATURE (THERMOMETERS–PYROMETERS–ETC.)*

AGA Corp of America ..... P O Box 447, South Plainfield ..... NJ
Bailey Meter Co ..... 1050 Ivanhoe Rd, Cleveland ..... Ohio
Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
Daystrom, Inc, Weston Instruments Div ..... 614 Frelinghuysen Ave, Newark ..... NJ
FOXBORO CO., Adv Pg 316 ..... **Foxboro** ..... **Mass**
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Hays Corp ..... 742 E 8 St, Michigan City ..... Ind
Leeds & Northrup Co ..... 4970 Stenton Ave, Philadelphia 44 ..... Pa
Minneapolis-Honeywell Regulator, Brown
Instrument Div ..... Wayne & Windrim Ave, Philadelphia 44 ..... Pa
Precision Thermometer & Instrument Co ..... 1434 Brandywine St, Philadelphia 30 ..... Pa
Taylor Instrument Cos ..... 95 Ames St, Rochester 1 ..... NY
U S Gauge Div, American Machine & Metals ..... Sellersville ..... Pa
Vapor Recovery Systems Co ..... 2820 N Alameda St, Compton ..... Cal

METERS & GAGES–*ETC.–TIME (CLOCKS–ETC.)*

Dyna Metric, Inc ..... 2955 E Colorado Blvd, Pasadena ..... Cal
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... **Schenectady 5** ..... **NY**
Rockwell Mfg Co ..... 400 N Lexington Ave, Pittsburgh 8 ..... Pa

MILL BALLS & SIMILIAR MEDIA–*GRINDING*

Abbe Engineering Co ..... 622C Graybar Bldg, New York 17 ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
American Steel & Wire Div, U.S. Steel Corp ..... 614 Superior NW, Cleveland 13 ..... Ohio
Bico, Inc ..... Box 3086, Glenoaks Sta, Burbank ..... Cal
Booth Co, Inc ..... 333 W 14 S, Salt Lake City 15 ..... Utah
Calumet Div, Calumet & Hecla, Inc ..... Calumet ..... Mich
COATES STEEL PRODUCTS CO., Adv Pg 336 ..... **Greenville** ..... **Ill**
Colorado Fuel & Iron Corp ..... 575 Madison Ave, New York 22 ..... NY
COLORADO FUEL & IRON CORP.,
Adv. Pgs. 32-33 ..... **Continental Oil Bldg, Denver 2** ..... **Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp ..... 120 Montgomery St, San Francisco 6 ..... Cal
COORS PORCELAIN CO., Adv Pg 138 ..... **600 Ninth St, Golden** ..... **Colo**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
Endicott Forging & Mfg Co ..... 1901 North St, Endicott ..... NY
Galigher Co ..... Box 209, Salt Lake City 10 ..... Utah
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St, York** ..... **Pa**
KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
MINE & SMELTER SUPPLY CO.,
Adv. Pgs. 322-323 ..... **Box 9041, Denver 16** ..... **Colo**
NAT'L MALLEABLE & STEEL CASTINGS,
CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310 ..... **Phoenix** ..... **Ariz**
National Tube Div, U.S. Steel Corp ..... 525 William Penn Pl, Pittsburgh ..... Pa
SHEFFIELD DIV. ARMCO STEEL CORP.,
Adv Pg 66 ..... **Sheffield Sta, Kansas City 25** ..... **Mo**
Southwestern Engineering Co ..... 4800 Santa Fe Ave, Los Angeles 58 ..... Cal
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... **148 Cedar St, New York 6** ..... **NY**
U S STEEL CORP., Adv. Pgs. 12, 280 ..... **525 Wm Penn Pl, Pittsburgh 30** ..... **Pa**
U S Stoneware Co ..... Akron 9 ..... Ohio

MILL LINERS–*GRINDING*

Abbe Engineering Co ..... 622C Graybar Bldg, New York 17 ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
American Brake Shoe Co ..... 530 Fifth Ave, New York 36 ..... NY
AMERICAN BRAKE SHOE CO. AMERICAN
MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... **389 E 14 St, Chicago Heights** ..... **Ill**
American Steel & Wire Div, U.S. Steel Corp ..... 614 Superior NW, Cleveland 13 ..... Ohio
Baldwin-Lima-Hamilton Corp, Standard Steel
Works Div ..... Burnham ..... Pa
BETHLEHEM STEEL CO., Adv Pg 46 ..... **Bethlehem** ..... **Pa**
Calumet Div, Calumet & Hecla, Inc ..... Calumet ..... Mich
Coeur D'Alenes Co ..... Wallace ..... Idah
Columbia-Geneva Steel Div, U.S. Steel Corp ..... 120 Montgomery St, San Francisco 6 ..... Cal
COORS PORCELAIN CO., Adv Pg 138 ..... **600 Ninth St, Golden** ..... **Colo**
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
EIMCO CORP., Adv Pg 335 ..... **501 W 6th South St, Salt Lake City 10** ..... **Utah**
Electric Steel Foundry Co ..... 214 NW 25 Ave, Portland 10 ..... Ore
Frog, Switch & Mfg Co ..... Carlisle ..... Pa
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St, York** ..... **Pa**
KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
MINE & SMELTER SUPPLY CO.,
Adv. Pgs. 322-323 ..... **Box 9041, Denver 16** ..... **Colo**
NAT'L MALLEABLE & STEEL CASTINGS,
CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310 ..... **Phoenix** ..... **Ariz**
National Tube Div, U.S. Steel Corp ..... 525 William Penn Pl, Pittsburgh ..... Pa
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**
SMIDTH, F. L. & CO., Adv Pg 141 ..... **Rockefeller Center, New York 20** ..... **NY**
Sorel Steel Foundries Ltd ..... 1405 Peel St, Montreal 2, P.Q. ..... Can
Thomas Foundries Inc ..... Box 1111, Birmingham 1 ..... Ala
Tool Steel Gear & Pinion Co ..... 211 Township Ave, Cincinnati 16 ..... Ohio
U S STEEL CORP., Adv. Pgs. 12, 280 ..... **525 Wm Penn Pl, Pittsburgh 30** ..... **Pa**
U S Stoneware Co ..... Akron 9 ..... Ohio

MILL RODS–*GRINDING*

Abbe Engineering Co ..... 622C Graybar Bldg, New York 17 ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Colorado Fuel & Iron Corp ..... 575 Madison Ave, New York 22 ..... NY
COLORADO FUEL & IRON CORP.,
Adv. Pgs. 32-33 ..... **Continental Oil Bldg, Denver 2** ..... **Colo**
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St, York** ..... **Pa**
KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
MINE & SMELTER SUPPLY CO.,
Adv. Pgs. 322-323 ..... **Box 9041, Denver 16** ..... **Colo**
SMIDTH, F. L. & CO., Adv Pg 141 ..... **Rockefeller Center, New York 20** ..... **NY**
U S STEEL CORP., Adv. Pgs. 12, 280 ..... **525 Wm Penn Pl, Pittsburgh 30** ..... **Pa**

MILL SHELLS–*GRINDING*

Abbe Engineering Co ..... 622C Graybar Bldg, New York 17 ..... NY
ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Baldwin-Lima-Hamilton Corp, Standard Steel
Works Div ..... Burnham ..... Pa
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
Electric Steel Foundry Co ..... 214 NW 25 Ave, Portland 10 ..... Ore
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St, York** ..... **Pa**
KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
MINE & SMELTER SUPPLY CO.,
Adv. Pgs. 322-323 ..... **Box 9041, Denver 16** ..... **Colo**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**
SMIDTH, F. L. & CO., Adv Pg 141 ..... **Rockefeller Center, New York 20** ..... **NY**
Tool Steel Gear & Pinion Co ..... 211 Township Ave, Cincinnati 16 ..... Ohio

MILLS–*GRINDING AUTOGENOUS*

Black's Machine Shop ..... 169 Willow St, Bishop ..... Cal
Combustion Engineering, Inc ..... 200 Madison Ave, New York 16 ..... NY
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
GENERAL AMERICAN TRANSPORTATION CORP.,
Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... **240 Arch St, York** ..... **Pa**

MILLS–*GRINDING–BALL–PEBBLE–ROD & TUBE*

ALLIS-CHALMERS MFG CO. INDUSTRIES
GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Bico, Inc ..... Box 3086, Glenoaks Sta, Burbank ..... Cal
Black's Machine Shop ..... 169 Willow St, Bishop ..... Cal
Crossley Machine Co ..... Mammoth & Bell Sts, Trenton ..... NJ
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
EIMCO CORP., Adv Pg 335 ..... **501 W 6th South St, Salt Lake City 10** ..... **Utah**
Engelhard Industries, Inc ..... 113 Astor St, Newark ..... NJ
GENERAL AMERICAN TRANSPORTATION CORP.,
Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
KENNEDY VAN SAUN MFG & ENG CORP.,
Adv Pg 129 ..... **405 Park Ave, New York 22** ..... **NY**
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**
SMIDTH, F. L. & CO., Adv Pg 141 ..... **Rockefeller Center, New York 20** ..... **NY**
STEARNS ROGER MFG CO., Adv Pg 291 ..... **660 Bannock St, Denver 17** ..... **Colo**
STRAUBE MFG CO., Adv Pg 359 ..... **8381 Baldwin St, Oakland 21** ..... **Cal**
TRAYLOR ENGINEERING & MFG. DIV OF
FULLER CO., Adv. Pgs. 25, 26-27, 28 ..... **Mill St, Allentown** ..... **Pa**
U S Stoneware Co ..... Akron 9 ..... Ohio

MILLS–*MOBILE UNIT (COMPLETE ORE DRESSING)–DOES NOT INCLUDE CRUSHERS–MOBILE UNITS ALONE*

Abbe Engineering Co ..... 622C Graybar Bldg, New York 17 ..... NY
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DENVER EQUIPMENT CO., Adv Pg 76 ..... **Box 5268, Denver 17** ..... **Colo**
Dominion Engineering Co, Ltd ..... Box 220, Montreal, Quebec ..... Can
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo

MILLS–*PUG–See* SCRUBBERS

MINE CARS–*See* CARS–*MINE*

MINE DOORS (INCLUDING AUTOMATIC PRESSURE–*SAFETY–WATERTIGHT –ETC.)*

AMERICAN MINE DOOR CO., Adv Pg 324 ..... **3939 Dunbar Ave, STE, Canton 6** ..... **Ohio**
Coeur D'Alenes Co ..... Wallace ..... Idah
The Rockiron Co, Ltd ..... P O Box 1089, Sudbury ..... Ont
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... **148 Cedar St, New York 6** ..... **NY**

MINE SUPPORTS–*See BELOW: Also See* STEEL; ROCK BOLTS; FENCING–*METAL WIRE)*

MINE SUPPORTS–*METAL PROPS (INCLUDING RE-USABLE–MOVABLE & YIELDABLE TYPES)*

Acrow Corp of America ..... 231 Washington Ave, Carlstadt ..... NJ
Coeur D'Alenes Co ..... Wallace ..... Idah
Commercial Shearing & Stamping Co ..... Dept. EMJ-MG, 1775 Logan Ave, Youngstown ..... Ohio
Irwin Sensenich Corp ..... Box 311, Irwin ..... Pa
The Rockiron Co, Ltd ..... P O Box 1089, Sudbury ..... Ont
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

MINE SUPPORTS–METAL–SETS & ARCH PLATES

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave, Youngstown	Ohio
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont

MINE SUPPORTS–METAL YIELDABLE SETS & ARCHES

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave, Youngstown	Ohio
Irwin Sensenich Corp	Box 311, Irwin	Pa
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont

MINERAL DEALERS & SALES AGENTS

Associated Metals & Minerals Corp	75 West St, New York 6	NY
De Sousa, J. E., Co., Inc	100 Church St, New York 7	NY
Diamond, T. L., & Co	1 Wall St, New York 5	NY
E A Goday & Co, Inc	25 Broadway, New York 4	NY
INTERNATIONAL BARTERING CO., Adv Pg 358	**52 Broadway, New York**	**NY**
Resource Americas Corp	P O Box 945, Santa Monica	Cal
Scott Williams Mineral Co, Inc	440 N Scottsdale Rd, Scottsdale	Ariz
Texas Gulf Sulphur Co	75 E 45 St, New York	NY

MINERAL SPECIMENS

Lawrence H. Conklin	31 W 47th St, New York City 6	NY
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo
Scott Williams Mineral Co, Inc	440 N Scottsdale Rd, Scottsdale	Ariz

MIXERS–See AGITATORS

MONITOR–HYDRAULIC (WATER)

Elkhart Brass Mfg Co, Inc	1302 W Beardsley Ave, Elkhart	Ind
Georgia Iron Works Co	605 12th St, Augusta	Ga

MONORAIL TRANSPORTS–TROLLEY–DOES NOT INCLUDE CONVEYORS–TROLLEY; CRANES–OVERHEAD TRAVELING; AERIAL CABLEWAYS

Chisholm-Moore Hoist Div, Columbus McKinnon Corp	5045 Fremont Ave, Tonawanda	NY
The Forker Corp	2044 Random Rd, Cleveland 6	Ohio
Louden Machinery Co	607 Broadway, Fairfield	Iowa
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
Whiting Corp	157 & Lathrop, Harvey	Ill

MOTORS–See AIR MOTORS; ELECTRIC MOTORS; HYDRAULIC MOTORS

MUCKING MACHINES–See LOADERS

NODULIZING EQUIPMENT–Also See SINTERING EQUIPMENT; PELLETIZING EQUIP.; BRIQUETTING EQUIP.

HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St, York**	**Pa**
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave, New York 22**	**NY**
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave, NE, Cleveland 14**	**Ohio**
TREADWELL, H.N., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**

NOZZLES–DOES NOT INCLUDE MONITORS–HYDRAULIC

Bete Fog Nozzle, Inc	309 Wells St, Greenfield	Mass
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Elkhart Brass Mfg Co, Inc	1302 W Beardsley Ave, Elkhart	Ind
Fairmont Machinery Co	Fairmont	W Va
OPW-Jordan	6013 Wiehe Rd, Cincinnati 13	Ohio
U S Stoneware Co	Akron 9	Ohio

NOZZLES–SPRAY

Bete Fog Nozzle, Inc	309 Wells St, Greenfield	Mass
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Booth Co, Inc	333 W 1 S, Salt Lake City 15	Utah
CHAIN BELT CO., Adv Pg 331	**4479 W Greenfield Ave, Milwaukee 1**	**Wis**
DEISTER CONCENTRATOR CO. INC., Adv Pg 362	**903 Glasgow Ave, Ft Wayne**	**Ind**
Elkhart Brass Mfg Co, Inc	1302 W Beardsley Ave, Elkhart	Ind
Gray & Co, Inc	60-11 Ave, NE, Minneapolis 13	Minn
Grinnell Co, Inc	260 W Exchange St, Providence 1	RI
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont
Sanford-Day Corp	Dale Ave, Knoxville 9	Tenn
SPRAYING SYSTEMS CO., Adv Pg 338	**3201 Randolph St, Bellwood**	**Ill**
Yamall-Waring Co	102 E Mermaid Ln, Philadelphia 18	Pa

OFFICE MACHINES & EQUIPMENT–DOES NOT INCLUDE COMPUTING MACHINES; DRAFTING EQUIP.

AGA Corp of America	P O Box 447, South Plainfield	NJ
Geo-Optic & Paper Corp	149 Church St, New York 7	NY
Remington Rand Div, Sperry Rand Corp	315 Park Ave, S, New York 10	NY

ORE–DEALERS–See MINERAL DEALERS AND SALES AGENTS

PACKING

ACME HAMILTON MFG CORP., Adv Pg 166	**Meade St, Trenton 3**	**NJ**
AMERICAN BILTRITE RUBBER CO. BOSTON WOVEN HOSE & RUBBER DIV., Adv Pg 125	**Boston 3**	**Mass**
Continental Rubber Works	1939 Liberty St, Erie	Pa
Garlock Inc	402 E Main St, Palmyra	NY
Goodall Rubber Co	Whitehead Rd, Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
Greene, Tweed & Co	North Wales	Pa
Johns-Manville	22 E 40 St, New York 16	NY
Keasbey & Mattison Co	Ambler	Pa
Byars, A. M. Co	Clark Bldg, Pittsburgh 22	Pa
Carlon Products Corp	Box 133, Aurora	Ohio
Continental-Diamond Fibre Corp, Sub. Budd Co	Newark	Del
Evanite Plastic Co, Div of The Evans Pipe Co	Carrollton	Ohio
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Gates Rubber Co	999 S Broadway, Denver 17	Colo
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St, Chicago 3**	**Ill**
Goodall Rubber Co	Whitehead Rd, Trenton	NJ
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
Grinnell Co, Inc	260 W Exchange St, Providence 1	RI
Johns-Manville	22 E 40 St, New York 16	NY
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Keasbey & Mattison Co	Ambler	Pa
Luzerne Rubber Co	Muirhead & Dewey Sts, Trenton 7	NJ
NATIONAL MINE SERVICE CO., Adv Pg 146	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg, Cleveland 1**	**Ohio**
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Synthane Corp	River Rd, Oaks	Pa
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

RAYBESTOS-MANHATTAN INC. MANHATTAN RUBBER DIV., Adv. Pgs. 82-83

	42 Townsend St, Passaic	**NJ**
Republic Rubber Div, Lee Rubber & Tire Corp	Albert St, Youngstown	Ohio
Rhoads, J. E., & Son	2100 W 11 St, Wilmington 99	Del
Thermoid Div, H. K. Porter Co, Inc	Whitehead Rd, Trenton 6	NJ
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY

PAINTS–Also See COATINGS

Canadian Industries, Ltd	Box 10, Montreal	Can
Carbolineum Wood Preserving Co	6683 W 40th St, Milwaukee 9	Wis
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
Sherwin-Williams Co	101 Prospect Ave, NW, Cleveland 1	Ohio

PELLETIZING–BALLING EQUIPMENT–DOES NOT INCLUDE SINTERING EQUIP.; NODULIZING EQUIP.; BRIQUETTING EQUIP.

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
Dravo Corp	Neville Island, Pittsburgh 25	Pa
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St, York**	**Pa**
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave, New York 22**	**NY**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave, NE, Cleveland 14**	**Ohio**
Stroh Process Steel Co	Calif & Marvista Aves, Pittsburgh 12	Pa

PETROLEUM PRODUCTS Also See LUBRICANTS

Alemite Div, Stewart-Warner Corp	1826 Diversey Pkwy, Chicago 14	Ill
Atlantic Refining Co	260 S Broad St, Philadelphia	Pa
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Esso Standard Div, Humble Oil & Refining Co	15 W 51 St, New York 19	NY
Hulburt Oil & Grease Co	Trenton & Castor Aves, Phila 34	Pa
Jet-Lube, Inc	P O Box 3126, Burbank	Cal
STANDARD OIL CO OF CALIFORNIA, WESTERN OPERATIONS INC., Adv Pg 35	**225 Bush St, San Francisco 20**	**Cal**
TEXACO INC., Adv Pg 119	**135 E 42 St, New York 17**	**NY**
Tidewater Oil Co	660 Madison Ave, New York 21	NY

PH INDICATORS–See METERS–CHEMICAL

PHOTOCOPY EQUIPMENT–See BLUEPRINT MACHINES

PICKS–See GEOLOGIST'S EQUIPMENT; TOOLS

PIPE & TUBING–See BELOW; Also See ELECTRICAL CONDUIT

PIPE–ASBESTOS & CEMENT

Johns-Manville	22 E 40 St, New York 16	NY
Keasbey & Mattison Co	Ambler	Pa

PIPE–IRON & STEEL

Alco Products Inc	Dept. 915, Schenectady 5	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St, Chicago Heights**	**Ill**
American Cast Iron Pipe Co	2930 16th St, N, Birmingham 2	Ala
Armco Drainage & Metal Products	Middletown	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Byers, A. M. Co	Clark Bldg, Pittsburgh 22	Pa
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343	**P O Box 88, Pittsburgh 30**	**Pa**
Duriron Co, Inc	450 N Findlay St, Dayton 4	Ohio
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Metal Goods Corp	8800 Page Blvd, St Louis 14	Mo
National Supply Div, Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
NAYLOR PIPE CO., Adv Pg 145	**1243 E 92 St, Chicago 19**	**Ill**
Pacific Foundry & Metallurgy Co	3100 Nineteenth St, San Francisco 10	Cal
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg, Cleveland 1**	**Ohio**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
U S Pipe & Foundry Co	3300 First Ave, N, Birmingham 2	Ala
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
Wheeling Steel Corp	1134-1140 Market St, Wheeling	W Va
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave, New York 22**	**NY**
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

PIPE (METAL)–NON-METALLIC LINED

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Galigher Co	Box 209, Salt Lake City 10	Utah
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Luzerne Rubber Co	Muirhead & Dewey Sts, Trenton 7	NJ
Mercer Rubber Co	136 Mercer St, Trenton 90	NJ

PIPE–NONFERROUS METAL

Aluminum Co of America	1501 Alcoa Bldg, Pittsburgh 19	Pa
Ampco Metal, Inc	1739 S 38 St, Milwaukee 1	Wis
Belmont Smelting & Refining Works	330 Belmont Ave, Brooklyn 7	NY
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343	**P O Box 88, Pittsburgh 30**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
Metal Goods Corp	8800 Page Blvd, St Louis 14	Mo
PHELPS DODGE COPPER PRODUCTS, Adv Pg 165	**300 Park Ave, New York 22**	**NY**
Revere Copper & Brass Inc	230 Park Ave, New York 17	NY
Reynolds Metals Co	Box 2346-ZK, Richmond 18	Va
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill

PIPE–PLASTIC

ACME HAMILTON MFG CORP., Adv Pg 166	**Meade St, Trenton 3**	**NJ**
Amercoat Corp	4809 Firestone Blvd, South Gate	Cal

PIPE–VENTILATION–DOES NOT INCLUDE VENTILATION TUBING–NON-METALLIC

Coeur D'Alenes Co	Wallace	Idah
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
NAYLOR PIPE CO., Adv Pg 145	**1243 E 92 St, Chicago 19**	**Ill**
The Rockiron Co, Ltd	P O Box 1089, Sudbr	Ont

PIPE–WOOD

Arrow Tank Co	16 Barnett St, Buffalo 15	NY
Fluor Products Co	Box 1267, Santa Rosa	Cal
Hauser-Stander Tank Co	4820 Spring Grove Ave, Cincinnati 32	Ohio
Pacific Wood Tank Div, Sauers Forest Prods Inc	Box 188, Healdsburg	Cal
Yamall-Waring Co	102 E Mermaid Ln, Philadelphia 18	Pa

PIPE FITTINGS–Also See PIPE LINE TRAPS; NOZZLES; VALVES

Aluminum Co of America	1501 Alcoa Bldg, Pittsburgh 19	Pa
Ampco Metal, Inc	1739 S 38 St, Milwaukee 1	Wis
Anchor Coupling Co, Inc	342 N Fourth St, Libertyville	Ill
Carlon Products Corp	Box 133, Aurora	Ohio
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Chiksan Co	330 N Brea Blvd, Brea	Cal
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343	**P O Box 88, Pittsburgh 30**	**Pa**
Dart Union Co	134 Thurbers Ave, Providence 5	RI
Dresser Mfg Div, Dresser Industries, Inc	Bradford	Pa
Eastern Sales Co, Div of The Eastern Co	Box 10621, Pittsburgh 36	Pa
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Evanite Plastic Co, Div of The Evans Pipe Co	Carrollton	Ohio
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Grinnell Co, Inc	260 W Exchange St, Providence 1	RI
Johns-Manville	22 E 40 St, New York 16	NY
Knox Mfg Co	222 W Clinton Ave, Oaklyn	NJ
Ladish Co	5481 S Packard Ave, Cudahy	Wis
Luzerne Rubber Co	Muirhead & Dewey Sts, Trenton 7	NJ
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NAYLOR PIPE CO., Adv Pg 145	**1243 E 92 St, Chicago 19**	**Ill**
OPW-Jordan	6013 Wiehe Rd, Cincinnati 13	Ohio
Parker-Hannifin Corp	17325 Euclid Ave, Cleveland 12	Ohio
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Stockham Valves & Fittings	Box 2592, Birmingham	Ala
U S Pipe & Foundry Co	3300 First Ave, N, Birmingham 2	Ala
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
VICTAULIC CO OF AMERICA, Adv Pg 334	**P O Box 509E, Elizabeth**	**NJ**
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
The Weatherhead Co	300 E 131st St, Cleveland 8	Ohio
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

PIPELINE TRAPS–AIR-STEAM & WATER

ERIEZ MFG CO., Adv Pg 365	**315 Magnet Dr, Erie**	**Pa**
Farris Corp	400 Commercial Ave, Palisades Park	NJ
Farris Flexible Valve Corp	463 Commercial Ave, Palisades Park	NJ
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Schramm Inc	870 E Virginia Ave, West Chester	Pa
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
Wilkerson Corp	1604 W Mansfield Ave, Englewood	Colo
Yamall-Waring Co	102 E Mermaid Ln, Philadelphia 18	Pa

PNEUMATIC–See AIR

POWDER BAGS–See BLASTING BAGS

POWER PLANTS–See ELECTRIC GENERATING POWER PLANTS

POWER SHOVELS–See EXCAVATORS

POWER TAKE-OFFS–Also See DRIVES

Failing, George E., Co	Enid	Okla
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
Farris Corp	400 Commercial Ave, Palisades Park	NJ
Farris Flexible Valve Corp	463 Commercial Ave, Palisades Park	NJ
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65	**2301 N Adams St, Peoria**	**Ill**
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla
Twin Disc Clutch Co	Racine	Wis

PROFESSIONAL SERVICES–See CONSULTANTS: CONTRACTORS: LABORATORY SERVICE

PROTECTIVE CLOTHING–See SAFETY CLOTHING

PUG MILLS–See SCRUBBERS

PULLEYS–See BLOCKS

PULLEYS–*MAGNETIC*–See SEPARATORS–*MAGNETIC*

PULVERIZERS–*Also See* CRUSHERS: *MILLS–GRINDING*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Pulverizer Co	1275 Macklind Ave. St Louis 10	Mo
Babcock & Wilcox Co	161 E 42nd St. New York 17	NY
Bicu, Inc	Box 3086, Glenoaks Sta. Burbank	Cal
Braun Chemical Co	2030 E Broadway, Tucson	Ariz
Crossley Machine Co	Mammoth & Bell Sts. Trenton	NJ
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
T. J. Gundlach Machine Co Div of J.M.J. Industries, Inc	#1 Freedom Dr, Belleville	Ill
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
Jeffrey Mfg Co	886 N 4th St. Columbus 16	Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave. New York 22**	**NY**
Majac Inc	23rd St. Pittsburgh 15	Pa
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
Pioneer Engineering, Div of Poor & Co. Inc	3200 Como Ave. SE, Minneapolis 14	Minn
Pulva Corp	602 High St. Perth Amboy	NJ
Simmons Boiler & Machine Co	9011 Central Ave. Detroit 4	Mich
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St. Boston 22**	**Mass**

PUMP ACCESSORIES

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
Barnes Mfg Co	651 N Main St. Mansfield	Ohio
Barrett Haentjens & Co	Hazleton	Pa
Dean Hill Corp	4000 E 16 St. Indianapolis 7	Ind
Deming Co	542 Broadway, Salem	Ohio
FLYGT CORP., Adv Pg 5	**Hoosick Falls**	**NY**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Homelite, Div of Textron Inc	75 Riverdale Ave. Port Chester	NY
Lancaster Pump & Mfg Co., Inc	Lancaster	Pa
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
Megator Corp	930 Machester Ave, Pittsburgh 12	Pa
The Weatherhead Co	300 E 131st St. Cleveland 8	Ohio

PUMPS–*AIR DRIVEN*

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave. New York 17**	**NY**
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex LA 54	Cal
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Crossley Machine Co	Mammoth & Bell Sts. Trenton	NJ
M. T. Davidson Co	7 Dey St. New York 7	NY
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Gray & Co. Inc	60-11 Ave. NE, Minneapolis 13	Minn
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301	**Sidney**	**Ohio**
Lincoln Engineering Co. Div. McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
Thor Power Tool Co	175 N State St. Aurora	Ill
Warren Pumps Inc	606 Bridges Ave. Warren	Mass

PUMPS–*AIR LIFT*

Nash Engineering Co	218 Wilson Rd. South Norwalk	Conn

PUMPS–*CENTRIFUGAL & TURBINE*

ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
Ampco Metal, Inc	1739 S 38 St. Milwaukee 1	Wis
Barrett Haentjens & Co	Hazleton	Pa
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
Carver Pump Co	1056 Hershey Ave. Muscatine	Iowa
M. T. Davidson Co	7 Dey St. New York 7	NY
Dean Hill Corp	4000 E 16 St. Indianapolis 7	Ind
Deming Co	542 Broadway, Salem	Ohio
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
Duriron Co. Inc	450 N Findlay St. Dayton 4	Ohio
Essick Mfg Co	1950 Santa Fe Ave. Los Angeles 21	Cal
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
Fairmont Machinery Co	Fairmont	W Va
Flood City Brass & Electric Co	Johnstown	Pa
FLYGT CORP., Adv Pg 5	**Hoosick Falls**	**NY**
Galigher Co	Box 209, Salt Lake City 10	Utah
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Gorman Rupp Co	Mansfield	Ohio
Goulds Pumps, Inc	Seneca Falls	NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Jaeger Machine Co	550 W Spring St. Columbus 16	Ohio
Kenco Pump Div. American Crucible Products Co	1305 Oberlin Ave. Lorain	Ohio
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Lawrence Pumps, Inc	371 Market St. Lawrence	Mass
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Megator Corp	930 Machester Ave. Pittsburgh 12	Pa
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Morris Machine Works	Baldwinsville	NY
NAGLE PUMPS INC., Adv Pg 360	**1329 Center St. Chicago Heights**	**Ill**
New York Air Brake Co. Aurora Pump Div	86 Laucks St. Aurora	Ill
Peerless Pump, Hydrodynamics Div. Food Machinery & Chemical Corp	301 West Ave. 26, Los Angeles 31	Cal
Pennsylvania Pump & Compressor Co	Easton	Pa
Rice Pump & Machine Co	Belgium	Wis
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327	**900 W Mount St. Connersville**	**Ind**
Solar Aircraft Co	2200 Pacific Hwy. San Diego 12	Cal
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Warren Pumps Inc	606 Bridges Ave. Warren	Mass
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**
Wheeler, C. H., Mfg Co	19th & Lehigh Ave. Philadelphia 32	Pa
A. R. WILFLEY & SONS, INC., Adv Pg 84	**P O Box 2330, Denver 1**	**Colo**

PUMPS–*CONCRETE & REFRACTORY*–See CONCRETE: REFRACTORIES

PUMPS–*CORROSIVE LIQUIDS*

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Ampco Metal, Inc	1739 S 38 St. Milwaukee 1	Wis
B-I-F Industries, Inc	345 Harris Ave. Providence 1	RI
Barnes Mfg Co	651 N Main St. Mansfield	Ohio
Barrett Haentjens & Co	Hazleton	Pa
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Dean Hill Corp	4000 E 16 St. Indianapolis 7	Ind
Deming Co	542 Broadway, Salem	Ohio
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Dominion Engineering Co, Ltd	box 220, Montreal, Quebec	Can
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
Duriron Co. Inc	450 N Findlay St. Dayton 4	Ohio
Galigher Co	Box 209, Salt Lake City 10	Utah
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Gorman Rupp Co	Mansfield	Ohio
Goulds Pumps, Inc	Seneca Falls	NY
Gray & Co. Inc	60-11 Ave. NE, Minneapolis 13	Minn
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Johnston Pump Co	3272 E Foothill Blvd. Pasadena	Cal
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Lawrence Pumps, Inc	371 Market St. Lawrence	Mass
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Luzerne Rubber Co	Muirhead & Dewey Sts. Trenton 7	NJ
Marlow Pumps Div. Bell & Gossett Co	Box 2000, Midland Park	NJ
Megator Corp	930 Machester Ave. Pittsburgh 12	Pa
Morris Machine Works	Baldwinsville	NY
NAGLE PUMPS INC., Adv Pg 360	**1239 Center St. Chicago Heights**	**Ill**
National Carbon Co. Union Carbide Corp	270 Park Ave. New York 17	NY
National Supply Div. Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
New York Air Brake Co. Aurora Pump Div	86 Laucks St. Aurora	Ill
Peerless Pump, Hydrodynamics Div. Food Machinery & Chemical Corp	301 West Ave. 26, Los Angeles 31	Cal
Pennsylvania Pump & Compressor Co	Easton	Pa
Rice Pump & Machine Co	Belgium	Wis
Robbins & Myers Inc	1345 Lagonda Ave. Springfield	Ohio
Wallace & Tiernan Inc	Belleville 9	NJ
Warren Pumps Inc	606 Bridges Ave. Warren	Mass
Wheeler, C. H., Mfg Co	19th & Lehigh Ave. Philadelphia 32	Pa
A. R. WILFLEY & SONS, INC., Adv Pg 84	**P O Box 2330, Denver 1**	**Colo**

PUMPS–*DEEP WELL*–*Also See* PUMPS–*SUBMERSIBLE*

Barnes Mfg Co	651 N Main St. Mansfield	Ohio
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Deming Co	542 Broadway, Salem	Ohio
Fairbanks, Morse & Co	600 S Michigan Ave. Chicago 5	Ill
Goulds Pumps, Inc	Seneca Falls	NY
Jaeger Machine Co	550 W Spring St. Columbus 16	Ohio
Johnston Pump Co	3272 E Foothill Blvd. Pasadena	Cal
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Layne & Bowler Pump Co of L A	2940 S Vail Ave. Los Angeles 22	Cal
National Supply Div. Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
Peerless Pump, Hydrodynamics Div. Food Machinery & Chemical Corp	301 West Ave. 26, Los Angeles 31	Cal
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Wintroath Operations Vertical Pump Div. Worthington Corp	1100 S Meridian Ave. Alhambra	Cal

PUMPS–*DIAPHRAGM*

B-I-F Industries, Inc	345 Harris Ave. Providence 1	RI
Barnes Mfg Co	651 N Main St. Mansfield	Ohio
Carver Pump Co	1056 Hershey Ave, Muscatine	Iowa
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Dagley Mfg Co	1217 E Sixth St. Joplin	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer La. Stamford**	**Conn**
Essick Mfg Co	1950 Santa Fe Ave. Los Angeles 21	Cal
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Gorman Rupp Co	Mansfield	Ohio
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Homelite, Div of Textron Inc	75 Riverdale Ave. Port Chester	NY
Jaeger Machine Co	550 W Spring St. Columbus 16	Ohio
LAYTON CO., Adv Pg 359	**P O Box 87A, Cudahy**	**Wis**
Manzel Div. Houdaille Industries Inc	315 Babcock St. Buffalo 10	NY
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
Megator Corp	930 Machester Ave, Pittsburgh 12	Pa
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
Rice Pump & Machine Co	Belgium	Wis
Wallace & Tiernan Inc	Belleville 9	NJ

PUMPS–*DREDGE & GRAVEL*–*Also See* PUMPS–*SAND & SLIME*

ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Dagley Mfg Co	1217 E Sixth St. Joplin	Mo
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
ELLICOTT MACHINE CORP., Adv Pg 348	**1633 Bush St. Baltimore 30**	**Md**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Georgia Iron Works Co	605 12th St. Augusta	Ga
Hack Engineering Co	124 Wazee Market, Denver	Colo
Kansas City Hay Press	801 Woodswether Rd. Kansas City	Mo
Lawrence Pumps, Inc	371 Market St. Lawrence	Mass
Meckum Engineering Inc	Dayton Rd. Ottawa	Ill
Morris Machine Works	Baldwinsville	NY
NAGLE PUMPS INC., Adv Pg 360	**1239 Center St. Chicago Heights**	**Ill**
Pettibone Mulliken Corp	4710 W Division St. Chicago 51	Ill
Rice Pump & Machine Co	Belgium	Wis
Thomas Foundries Inc	Box 1111, Birmingham 1	Ala
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo

PUMPS–*HYDRAULIC FLUID*

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
American Brake Shoe Co	530 Fifth Ave. New York 36	NY
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave, Youngstown	Ohio
M. T. Davidson Co	7 Dey St. New York 7	NY
Deming Co	542 Broadway, Salem	Ohio
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Lincoln Engineering Co. Div. McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Oilgear Co	1560 W Pierce St. Milwaukee 4	Wis
Owatonna Tool Co	655 Cedar St. Owatonna	Minn
Parker-Hannifin Corp	17325 Euclid Ave. Cleveland 12	Ohio
Star Hydraulics Inc	2638 Davisson St. River Grove	Ill
Templeton, Kenly & Co	16th & Gardner Rd. Broadview	Ill
Vickers Inc	Administrative & Eng Center, Detroit 32	Mich
Warren Pumps Inc	606 Bridges Ave. Warren	Mass
The Weatherhead Co	300 E 131st St. Cleveland 8	Ohio

PUMPS–*HYDRAULIC RAM-TYPE*

Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Gray & Co, Inc	60-11 Ave. NE, Minneapolis 13	Minn
Lincoln Engineering Co. Div. McNeil Machine & Engineering Co	4010 Goodfellow Blvd. St Louis 20	Mo
Owatonna Tool Co	655 Cedar St. Owatonna	Minn
Star Hydraulics Inc	2638 Davisson St. River Grove	Ill
Templeton, Kenly & Co	16th & Gardner Rd. Broadview	Ill

PUMPS–*PISTON & PLUNGER*

ACKER DRILL CO. INC., Adv Pg 360	**Box 830, Scranton**	**Pa**
Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
B-I-F Industries, Inc	345 Harris Ave. Providence 1	RI
Barnes Mfg Co	651 N Main St. Mansfield	Ohio
BOYLES BROS DRILLING CO. LTD., Adv Pg 133	**1275-1291 Parker St. Vancouver 6**	**Can**
M. T. Davidson Co	7 Dey St. New York 7	NY
Deming Co	542 Broadway, Salem	Ohio
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
Flood City Brass & Electric Co	Johnstown	Pa
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy. Quincy**	**Ill**
Hypro Engineering, Inc	700 39 Ave. NE, Minneapolis 21	Minn
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Ledeen Mfg Co	3350 N Gilman Rd, El Monte	Cal
Manzel Div. Houdaille Industries Inc	315 Babcock St. Buffalo 10	NY
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
Mayhew Machine & Supply Co	Box 7726, Dallas	Tex
Megator Corp	930 Machester Ave, Pittsburgh 12	Pa
National Supply Div. Armco Steel Corp	P O Box 416, Pittsburgh 30	Pa
Star Hydraulics Inc	2638 Davisson St. River Grove	Ill
Wallace & Tiernan Inc	Belleville 9	NJ
Warren Pumps Inc	606 Bridges Ave. Warren	Mass

PUMPS–*PRIMING*

Barnes Mfg Co	651 N Main St. Mansfield	Ohio
Barrett Haentjens & Co	Hazleton	Pa
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Carver Pump Co	1056 Hershey Ave, Muscatine	Iowa
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave. Milwaukee 1**	**Wis**
Dominion Engineering Co. Ltd	Box 220, Montreal, Quebec	Can
Gorman Rupp Co	Mansfield	Ohio
Kenco Pump Div. American Crucible Products Co	1305 Oberlin Ave. Lorain	Ohio
Lawrence Pumps, Inc	371 Market St. Lawrence	Mass
Marlow Pumps Div. Bell & Gossett Co	Box 200, Midland Park	NJ
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NAGLE PUMPS INC., Adv Pg 360	**1239 Center St. Chicago Heights**	**Ill**
Nash Engineering Co	218 Wilson Rd. South Norwalk	Conn

PUMPS–*RECIPROCATING*–See **PUMPS**–*PISTON*

PUMPS–*ROTARY DISPLACEMENT*

Beach-Russ Co	420 Lexington Ave, New York	NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Deming Co	542 Broadway, Salem	Ohio
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Failing, George E., Co	Enid	Okla
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Goulds Pumps, Inc	Seneca Falls	NY
Hypro Engineering, Inc	700 39 Ave. NE., Minneapolis 21	Minn
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
Nash Engineering Co	718 Wilson Rd, South Norwalk	Conn
Oilgear Co	1560 W Pierce St, Milwaukee 4	Wis
Porta Pump Inc	19735 Ralston, Detroit 3	Mich
Robbins & Myers Inc	1345 Lagonda Ave, Springfield	Ohio
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327	**900 W Mount St. Connersville**	**Ind**
Sutorbilt Corp, Fuller Co	2966 E Victoria St, Compton	Cal
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Warren Pumps Inc	606 Bridges Ave, Warren	Mass

PUMPS–*SAND & SLIME*

ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 16 St. Chicago Heights**	**Ill**
Barrett Haentjens & Co	Hazleton	Pa
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Galigher Co	Box 209, Salt Lake City 10	Utah
Georgia Iron Works Co	605 12th St, Augusta	Ga
Hack Engineering Co	124 Wazee Market, Denver	Colo
Kansas City Hay Press	801 Woodswether Rd, Kansas City	Mo
Lawrence Pumps, Inc	371 Market St, Lawrence	Mass
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Morris Machine Works	Baldwinsville	NY
NAGLE PUMPS INC., Adv Pg 360	**1239 Center St. Chicago Heights**	**Ill**
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Robbins & Myers Inc	1345 Lagonda Ave, Springfield	Ohio
Thomas Foundries Inc	Box 1111, Birmingham 1	Ala
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Western Machinery Co, Wemco Div	650 Fifth St, San Francisco 7	Cal
A. R. WILFLEY & SONS, INC. Adv Pg 84	**P O Box 2330, Denver 1**	**Colo**

PUMPS–*SUBMERSIBLE*

American Crucible Products Co	1305 Oberlin Ave, Lorain	Ohio
Barnes Mfg Co	651 N Main St, Mansfield	Ohio
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Carver Pump Co	1056 Hershey Ave, Muscatine	Iowa
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Crossley Machine Co	Mammoth & Bell Sts, Trenton	NJ
Deming Co	542 Broadway, Salem	Ohio
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Dunnon Co, Inc	450 N Findlay St, Dayton 4	Ohio
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
FLYGT CORP., Adv Pg 5	**Keswick Falls**	**NY**
Gorman Rupp Co	Mansfield	Ohio
Goulds Pumps, Inc	Seneca Falls	NY
Jaeger Machine Co	550 W Spring St, Columbus 16	Ohio
Johnston Pump Co	3272 E Foothill Blvd, Pasadena	Cal
Kenco Pump Div, American Crucible Products Co	1305 Oberlin Ave, Lorain	Ohio
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Layne & Bowler Pump Co of L A	2943 S Vail Ave, Los Angeles 22	Cal
MACHINERY CENTER, INC., Adv Pg 356	**1281 S 4th West, Salt Lake City 10**	**Utah**
Motoramic Inc	2120 Market St, San Francisco 14	Cal
New York Air Brake Co, Aurora Pump Div	86 Laucks St, Aurora	Ill
Peerless Pump, Hydrodynamics Div, Food Machinery & Chemical Corp	301 West Ave, 26, Los Angeles 31	Cal
Sumo Pumps Inc	23 Brown House Rd, Stamford	Conn
Western Machinery Co, Wemco Div	650 Fifth St, San Francisco 7	Cal
Wintroath Operations, Vertical Pump Div, Worthington Corp	1100 S Meridian Ave, Alhambra	Cal

PUMPS–*SUMP*

ALLEN-SHERMAN-HOFF PUMP CO., Adv Pg 2nd Cover	**Box 635, Paoli**	**Pa**
Barnes Mfg Co	651 N Main St, Mansfield	Ohio
Barrett Haentjens & Co	Hazleton	Pa
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Byron Jackson Pumps, Inc. Sub of Borg-Warner Corp	Box 2017, Terminal Annex, LA 54	Cal
Carver Pump Co	1056 Hershey Ave, Muscatine	Iowa
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
M. T. Davidson Co	7 Dey St, New York 7	NY
Dean Hill Corp	4000 E 16 St, Indianapolis 7	Ind
Deming Co	542 Broadway, Salem	Ohio
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Flood City Brass & Electric Co	Johnstown	Pa
Galigher Co	Box 209, Salt Lake City 10	Utah
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy, Quincy**	**Ill**
Gorman Rupp Co	Mansfield	Ohio
Goulds Pumps, Inc	Seneca Falls	NY
Hypro Engineering, Inc	700 39 Ave. NE, Minneapolis 21	Minn
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Jaeger Machine Co	550 W Spring St, Columbus 16	Ohio
Johnston Pump Co	3272 E Foothill Blvd, Pasadena	Cal
Kenco Pump Div, American Crucible Products Co	1305 Oberlin Ave, Lorain	Ohio
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Lawrence Pumps, Inc	371 Market St, Lawrence	Mass
Layne & Bowler Pump Co of L A	2943 S Vail Ave, Los Angeles 22	Cal
LERDI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301	**Sidney**	**Ohio**
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Marlow Pumps Div, Bell & Gossett Co	Box 200, Midland Park	NJ
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
Morris Machine Works	Baldwinsville	NY
Motoramic Inc	2120 Market St, San Francisco 14	Cal
NAGLE PUMPS INC., Adv Pg 360	**1239 Center St. Chicago Heights**	**Ill**
New York Air Brake Co, Aurora Pump Div	86 Laucks St, Aurora	Ill
Peerless Pump, Hydrodynamics Div, Food Machinery & Chemical Corp	301 West Ave, 26, Los Angeles 31	Cal
Schramm Inc	870 E Virginia Ave, West Chester	Pa
Thor Power Tool Co	175 N State St, Aurora	Ill
Warren Pumps Inc	606 Bridges Ave, Warren	Mass
Western Machinery Co, Wemco Div	650 Fifth St, San Francisco 7	Cal
Wheeler, C. H., Mfg Co	19th & Lehigh Ave, Philadelphia 32	Pa
Wintroath Operations Vertical Pump Div, Worthington Corp	1100 S Meridian Ave, Alhambra	Cal

PUMPS–*VACUUM*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Barrett Haentjens & Co	Hazleton	Pa
Beach-Russ Co	420 Lexington Ave, New York	NY
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Engelhard Industries, Inc	113 Astor St, Newark	NJ
Fuller Co. Sub of General American Transportation Corp	Catasauqua	Pa
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy, Quincy**	**Ill**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hevi-Duty Electric Co	304 Hart St, Watertown	Wis
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Nash Engineering Co	718 Wilson Rd, South Norwalk	Conn
Pennsylvania Pump & Compressor Co	Easton	Pa
ROOTS-CONNERSVILLE BLOWER DIV. DRESSER INDUSTRIES INC., Adv Pg 327	**900 W Mount St. Connersville**	**Ind**
Sutorbilt Corp, Fuller Co	2966 E Victoria St, Compton	Cal
Wheeler, C. H., Mfg Co	19th & Lehigh Ave, Philadelphia 32	Pa

PYROMETERS–See **METERS**–*TEMPERATURE*

RADIATION DETECTORS

Bausch & Lomb Inc	83761 Bausch St, Rochester 2	NY
Curtiss-Wright Corp	Box 110, Princeton	NJ
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Fisher Research Laboratory, Inc	1975 University Ave, Palo Alto	Cal
GENERAL ELECTRIC CO. APPARATUS SALES, Adv. Pgs. 74, 167, 184	**Schenectady 5**	**NY**
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo
Moran Instrument Corp	170 E Orange Grove Ave, Pasadena 3	Cal
Philips Electronic Instruments	750 S Fulton Ave, Mt Vernon	NY

RADIO–See **COMMUNICATIONS**

RAIL BENDERS

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
NATIONAL MINE SERVICE CO., Adv Pg 146	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
Watt Car & Wheel Co	Barnesville	Ohio

RAIL BONDS

AGA Corp of America	P O Box 447, South Plainfield	NJ
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
NATIONAL MINE SERVICE CO., Adv Pg 146	**2530 Koppers Bldg. Pittsburgh 19**	**Pa**
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Ohio Brass Co	Mansfield	Ohio
Penn Machine Co	905 H. K. Porter Bldg, Pittsburgh 19	Pa
Penn Machine Co	106 Station St, Johnstown	Pa
Penn Machine Co	P O Box 24, Huntington	W Va

RAIL BRACES

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont

RAIL CLAMPS–*FISH-PLATES–TIE-PLATES & FROGS*

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg. Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frog, Switch & Mfg Co	Carlisle	Pa
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill

RAIL DRILLS & PUNCHES

Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave. Milwaukee 1**	**Wis**

RAIL SIGNALS–*Also See* **COMMUNICATIONS**

AGA Corp of America	P O Box 447, South Plainfield	NJ
AMERICAN MINE DOOR CO., Adv Pg 324	**2839 Booker Ave. SW, Canton 6**	**Ohio**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
General Railway Signal Co	Rochester 2	NY
MACNOD & U S SIGNAL CO., Adv Pg 354	**427 Louisville Ave. Louisville 9**	**Ky**
Union Switch & Signal Div, Westinghouse Air Brake Co	Swissvale	Pa

RAIL SPIKES

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg. Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

RAIL SWITCH THROWERS

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN MINE DOOR CO., Adv Pg 324	**2839 Booker Ave. SW, Canton 6**	**Ohio**
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
CHEATHAM ELECTRIC SWITCHING DEVICE CO., Adv Pg 354	**4700 Crittenden Dr. Louisville 9**	**Ky**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
General Railway Signal Co	Rochester 2	NY
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill

RAIL SWITCHES & CROSSINGS

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
Frog, Switch & Mfg Co	Carlisle	Pa
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Taylor Wharton Div, Harsco Corp	High Bridge	NJ

RAIL TIES–*STEEL*

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
West Virginia Works, Conners Steel Div, H. K. Porter Co, Inc	Box 118, Huntington 6	W Va

RAIL & TRACK

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg. Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
West Virginia Works, Conners Steel Div, H. K. Porter Co, Inc	Box 118, Huntington 6	W Va
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

RAIL & TRACK ACCESSORIES–*Also See SPECIFIC ITEM UNDER* **CAR—RAIL—OR TRACK**

American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN MINE DOOR CO., Adv Pg 324	**2839 Booker Ave. SW, Canton 6**	**Ohio**
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave. Denver 4**	**Colo**
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg. Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave, New York 17	NY
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Nolan Co	120 Pennsylvania St, Bowerston	Ohio
Ohio Brass Co	Mansfield	Ohio
Owatonna Tool Co	655 Cedar St, Owatonna	Minn
Pettibone Mulliken Corp	4710 W Division St, Chicago 51	Ill
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

REAGENT FEEDERS–See **FEEDERS**

REAGENTS—See CHEMICALS: FLOTATION REAGENTS: WATER CLARIFICATION CHEMICALS

RECTIFIERS—See ELECTRIC RECTIFIERS

REFRACTORIES—See *BELOW*: Also See INSULATION: FURNACE LININGS

REFRACTORIES—*BRICK*

Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
GENERAL REFRACTORIES CO., Adv Pg 147	**1520 Locust St, Philadelphia 2**	**Pa**
Gladding, McBean & Co	2901 Los Feliz Blvd, Los Angeles 39	Cal
Green Fire Brick Co	Mexico	Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78-79	**307 Fifth Ave, Pittsburgh 22**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
Kaiser Aluminum & Chemical Sales	300 Lakeside Dr, Oakland 12	Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc	300 Lakeside Dr, Oakland 12	Cal
National Carbon Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Norton Co	1 New Bond St, Worcester 6	Mass
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
H. K. Porter Co, Refractories Div	601 Grant St, Pittsburgh 19	Pa
Robinson Clay Product Co	65 W State St, Akron 9	Ohio

REFRACTORIES—*CASTABLE*

Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Baker & Adamson Products, General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
GENERAL REFRACTORIES CO., Adv Pg 147	**1520 Locust St, Philadelphia 2**	**Pa**
Gladding, McBean & Co	2901 Los Feliz Blvd, Los Angeles 39	Cal
Green Fire Brick Co	Mexico	Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78-79	**307 Fifth Ave, Pittsburgh 22**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
Kaiser Aluminum & Chemical Sales	300 Lakeside Dr, Oakland 12	Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc	300 Lakeside Dr, Oakland 12	Cal
Norton Co	1 New Bond St, Worcester 6	Mass
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
H. K. Porter Co, Refractories Div	601 Grant St, Pittsburgh 19	Pa
Robinson Clay Product Co	65 W State St, Akron 9	Ohio
SPANG & CO., Adv Pg 330	**143 Etna St, Butler**	**Pa**

REFRACTORY CEMENT

Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Bay-State Abrasive Products Co	12 Union St, Westboro	Mass
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Carey, Philip, Mfg Co	320 S Wayne Ave, Cincinnati 15	Ohio
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
Eagle - Picher Co	American Bldg, Cincinnati 1	Ohio
GENERAL REFRACTORIES CO., Adv Pg 147	**1520 Locust St, Philadelphia 3**	**Pa**
Gladding, McBean & Co	2901 Los Feliz Blvd, Los Angeles 39	Cal
Green Fire Brick Co	Mexico	Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78-79	**307 Fifth Ave, Pittsburgh 22**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
Kaiser Aluminum & Chemical Sales	300 Lakeside Dr, Oakland 12	Cal
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc	300 Lakeside Dr, Oakland 12	Cal
National Carbon Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Norton Co	1 New Bond St, Worcester 6	Mass
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
H. K. Porter Co, Refractories Div	601 Grant St, Pittsburgh 19	Pa
Robinson Clay Product Co	65 W State St, Akron 9	Ohio
SPANG & CO., Adv Pg 330	**143 Etna St, Butler**	**Pa**

REFRACTORY MATERIAL *OTHER THAN ABOVE*

Babcock & Wilcox Co	161 E 42nd St, New York 17	NY
Bigelow-Liptak Corp	13300 Puritan Ave, Detroit 27	Mich
Denver Fire Clay Co	3033 Blake St, Denver 17	Colo
Food Machinery & Chemical Corp, Mineral Products Div, Chlor-Alkali Div	161 E 42 St, New York 17	NY
GENERAL REFRACTORIES CO., Adv Pg 147	**1520 Locust St, Philadelphia 2**	**Pa**
Gladding, McBean & Co	2901 Los Feliz Blvd, Los Angeles 39	Cal
Green Fire Brick Co	Mexico	Mo
HARBISON-WALKER REFRACTORIES CO., Adv. Pgs. 78-79	**307 Fifth Ave, Pittsburgh 22**	**Pa**
Johns-Manville	22 E 40 St, New York 16	NY
Kaiser Aluminum & Chemical Sales	300 Lakeside Dr, Oakland 12	Cal
Norton Co	1 New Bond St, Worcester 6	Mass
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
H. K. Porter Co, Refractories Div	601 Grant St, Pittsburgh 19	Pa
Robinson Clay Product Co	65 W State St, Akron 9	Ohio

REFRACTORY PLACERS—*SPRAYERS—PUMPS & BLOWERS*—Also See CONCRETE PUMPS

Allentown Pneumatic Gun Co	1520 Walnut St, Allentown	Pa
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
GENERAL REFRACTORIES CO., Adv Pg 147	**1520 Locust St, Philadelphia 2**	**Pa**
Kaiser Refractories & Chemicals Div, Kaiser Aluminum & Chemical Sales Inc	300 Lakeside Dr, Oakland 12	Cal
Morris Machine Works	Baldwinsville	NY
SHEFFIELD DIV. ARMCO STEEL CORP., Adv Pg 363	**P O Box 214, Spruce Pine**	**NC**

RESPIRATORS—See SAFETY RESPIRATORS

RETORTS & DISTILLATION PROCESS EQUIPMENT—*LIQUID—DOES NOT INCLUDE BOILERS: LABORATORY EQUIPMENT*

Ames Iron Works, Inc	25 E 2 St, Oswego	NY
TREADWELL, W.H., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**

RETORTS & DISTILLATION PROCESS EQUIPMENT—*SOLID*—Also See FURNACES: KILNS: *DOES NOT INCLUDE LABORATORY EQUIPMENT*

GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St, Chicago 3**	**Ill**
Gould Gordon L, Co	58 Sutter St, San Francisco 4	Cal
TREADWELL, W.H., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**

ROCK (& ROOF) BOLT ACCESSORIES

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Bitco, Inc	Box 2646, Terminal Annex, Spokane 4	Wash
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy, Quincy**	**Ill**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Ohio Brass Co	Mansfield	Ohio
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg, Cleveland 1**	**Ohio**
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont
Sika Chemical Corp	35 Gregory Ave, Passaic	NJ
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave, New York 22**	**NY**

ROCK (& ROOF) BOLTS

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave, Youngstown	Ohio
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Ohio Brass Co	Mansfield	Ohio
Pattin Mfg Co, Div of Eastern Co	Box 659, Marietta	Ohio
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg, Cleveland 1**	**Ohio**
The Rockiron Co, Ltd	P O Box 1089, Sudbury	Ont
SHEFFIELD DIV. ARMCO STEEL CORP., Adv Pg 66	**Sheffield Sta, Kansas City 25**	**Mo**
West Virginia Works, Conners Steel Div, H. K. Porter Co, Inc	Box 116, Huntington 6	W Va
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave, New York 22**	**NY**

ROOF BOLTING MACHINES

CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St, New York 17**	**NY**
Fletcher, J. H. & Co	707 W 7th St, Huntington	W Va
GARDNER DENVER CO., Adv. Pgs. 142-143	**Gardner Expwy, Quincy**	**Ill**
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
LEROI DIV. WESTINGHOUSE AIR BRAKE CO., Adv. Pgs. 300-301	**Sidney**	**Ohio**
Long-Airdox Co, Marmon-Herrington Inc	P O Box 331, Oak Hill	W Va
MACHINERY CENTER, INC., Adv Pg 355	**1201 S 6th West, Salt Lake City 10**	**Utah**
Penn Machine Co	905 H. K. Porter Bldg, Pittsburgh 19	Pa
Penn Machine Co	106 Station St, Johnstown	Pa
Penn Machine Co	P O Box 24, Huntington	W Va
Sika Chemical Corp	35 Gregory Ave, Passaic	NJ

ROOFING & SIDING—*METAL*

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Huntington Alloy Products Div, The International Nickel Co, Inc	Huntington 17	W Va
Metal Goods Corp	6800 Page Blvd, St Louis 14	Mo
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg, Cleveland 1**	**Ohio**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
Wheeling Steel Corp	1134-1140 Market St, Wheeling	W Va

ROOFING & SIDING—*NON-METALLIC*

Carey, Philip, Mfg Co	320 S Qayne Ave, Cincinnati 15	Ohio
Daniels, C. R., Inc	Daniels	Md
Johns-Manville	22 E 40 St, New York 16	NY
Keasbey & Mattison Co	Ambler	Pa
Ruberoid Co	500 Fifth Ave, New York 36	NY
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY

RUST PREVENTIVES—See COATINGS

SAFETY CLOTHING—*GLOVES—HATS—BELTS—SHOES—ETC.*

American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Bausch & Lomb Inc	83761 Bausch St, Rochester 2	NY
Bullard, E. D., Co	2680 Bridgeway, Sausalito	Cal
Chicago Eye Shield Co	2727 W Roscoe St, Chicago 18	Ill
FILTRATION ENGINEERS DIV. (FEDC), AMERICAN MACHINE & METALS INC., Adv. Pgs. 293-293	**East Moline**	**Ill**
Goodall Rubber Co	Whitehead Rd, Trenton	NJ
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St, Akron 18**	**Ohio**
Industrial Air Products Co	3200 N W Yeon Ave, Portland 10	Ore
Johns-Manville	22 E 40 St, New York 16	NY
Keasbey & Mattison Co	Ambler	Pa
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Marquette Manufacturing Co, Div of Marquette Corp	307 E Hennepin Ave, Minneapolis 14	Minn
Miller Equipment Co, Inc	13 & New Sts, Franklin	Pa
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Pulmosan Safety Equipment Corp	644 Pacific St, Brooklyn	NY
Ray-O-Vac Co	212 E Washington Ave, Madison 10	Wis
Safety Clothing & Equipment Co	1995 E 69 St, Cleveland 3	Ohio
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
Wilson Rubber Co, A Div of Becton, Dickinson & Co	1200 Garfield Ave, SW, Canton 6	Ohio
Workion Inc	253 W 28 St, New York 1	NY

SAFETY EQUIPMENT & ACCESSORIES—*DOES NOT INCLUDE DUST SAMPLERS: SAFETY CLOTHING: SAFETY GOGGLES & MASKS: SAFETY POSTERS: SAFETY RESPIRATORS.* Also See *FIRE FIGHTING: FIRST AID: METERS*

American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Bullard, E. D., Co	2680 Bridgeway, Sausalito	Cal
Chicago Eye Shield Co	2727 W Roscoe St, Chicago 18	Ill
Falcon Alarm Co, Inc	243 Broad St, Summit	NJ
Harrington Co	Gravers Rd, Plymouth Meeting	Pa
Miller Equipment Co, Inc	13 & New Sts, Franklin	Pa
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Owatonna Tool Co	655 Cedar St, Owatonna	Minn
Pulmosan Safety Equipment Corp	644 Pacific St, Brooklyn	NY
Ray-O-Vac Co	212 E Washington Ave, Madison 10	Wis
Welsh Mfg Co	9 Magnolia St, Providence 9	RI

SAFETY GOGGLES & MASKS

American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Bausch & Lomb Inc	83761 Bausch St, Rochester 2	NY
Chicago Eye Shield Co	2727 W Roscoe St, Chicago 18	Ill
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Marquette Manufacturing Co, Div of Marquette Corp	307 E Hennepin Ave, Minneapolis 14	Minn
MINE SAFETY APPLIANCES CO., Adv Pg 117	**201 N Braddock Ave, Pittsburgh 8**	**Pa**
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Pulmosan Safety Equipment Corp	644 Pacific St, Brooklyn	NY
Ray-O-Vac Co	212 E Washington Ave, Madison 10	Wis
Scott Aviation Corp	Lancaster	NY
Welsh Mfg Co	9 Magnolia St, Providence 9	RI

SAFETY POSTERS—See SIGNS

SAFETY RESPIRATORS

American Optical Co, Safety Products Div	98 Mechanic St, Southbridge	Mass
Chicago Eye Shield Co	2727 W Roscoe St, Chicago 18	Ill
Flexo Products, Inc	24864 Detroit Rd, Westlake	Ohio
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
Pulmosan Safety Equipment Corp	644 Pacific St, Brooklyn	NY
Ray-O-Vac Co	212 E Washington Ave, Madison 10	Wis
Scott Aviation Corp	Lancaster	NY
Welsh Mfg Co	9 Magnolia St, Providence 9	RI

SAMPLING DEVICES—*ORE—CONCENTRATE—ETC. (MECHANICAL)—DOES NOT INCLUDE METERS*

Dagley Mfg Co	1217 E Sixth St, Joplin	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Gallagher Co	Box 209, Salt Lake City 10	Utah
Gilson Screen Co	110 Center St, Malinta	Ohio
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St, York**	**Pa**
MINE & SMELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**
STURTEVANT MILL CO., Adv Pg 362	**161 Clayton St, Boston 22**	**Mass**

SAWS—See *BELOW*: Also See TOOLS

SAWS & CHANNELERS: *ROCK—CONCRETE & MASONRY*

Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Porter-Cable Machine Co	700 Marcellus St, Syracuse 4	NY
WHEEL TRUEING TOOL CO., Adv Pg 3rd Cover	**3200 W Davison Ave, Detroit 38**	**Mich**

SCALES—See *BELOW*—Also See METERS

SCALES—*AUTOMATIC WEIGHING*—Also See FEEDERS

Atlas Car & Mfg Co	1100 Ivanhoe Rd, Cleveland 10	Ohio
B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Erie Strayer Co	Erie	Pa
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Howe Scale Co	Rutland	Vt
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342	**470 S 10 E, Salt Lake City 2**	**Utah**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
MERRICK SCALE MFG CO., Adv Pg 338	**184 Autumn St, Passaic**	**NJ**
Richardson Scale Co	Clifton	NJ
Schaffer Poidometer Co	2828 Smallman St, Pittsburgh 22	Pa
Thayer Scale	Pembroke	Mass
Thurman Scale Co	1939 Refugee Rd, Columbus	Ohio
Toledo Scale Div, Toledo Scale Corp	1112 Telegraph Rd, Toledo 12	Ohio

Trans-Weigh Corp	Box 415, King of Prussia	Pa
Wallace & Tiernan Inc	Belleville 9	NJ
Western Conveyor Co	Box 357, Boise	Idah

SCALES–*BELT CONVEYOR*

B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Howe Scale Co	Rutland	Vt
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342	**470 S 10 E, Salt Lake City 2**	**Utah**
McDOWELL CO. INC. THE WELLMAN ENGINEERING CO., Adv Pg 366	**113 St Clair Ave. NE, Cleveland 14**	**Ohio**
MERRICK SCALE MFG CO., Adv Pg 338	**184 Autumn St. Passaic**	**NJ**
Thayer Scale	Pembroke	Mass
Thurman Scale Co	1939 Refugee Rd, Columbus	Ohio
Toledo Scale Dlv, Toledo Scale Corp	1112 Telegraph Rd, Toledo 12	Ohio
Trans-Weigh Corp	Box 415, King of Prussia	Pa
Wallace & Tiernan Inc	Belleville 9	NJ
WEIGHING & CONTROLS, INC. SUB OF COMPUDYNE CORP., Adv Pg 347	**Industrial Park, E County Line Rd. Hatboro 10**	**Pa**
Western Conveyor Co	Box 357, Boise	Idah

SCALES–*ELECTRONIC*

Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill

SCALES–*PLATFORM*

Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Howe Scale Co	Rutland	Vt
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342	**470 S 10 E, Salt Lake City 2**	**Utah**
Thurman Scale Co	1939 Refugee Rd, Columbus	Ohio
Toledo Scale Dlv, Toledo Scale Corp	1112 Telegraph Rd, Toledo 12	Ohio

SCALES–*SACKING*

Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Howe Scale Co	Rutland	Vt
Richardson Scale Co	Clifton	NJ
Thayer Scale	Pembroke	Mass
Thurman Scale Co	1939 Refugee Rd, Columbus	Ohio
Toledo Scale Dlv, Toledo Scale Corp	1112 Telegraph Rd, Toledo 12	Ohio

SCALES–*WEIGH HOPPER–Also See* FEEDERS

Atlas Car & Mfg Co	1100 Ivanhoe Rd, Cleveland 10	Ohio
Bemis Bros. Bag Co	408 Pine St, St Louis 2	Mo
Bisco, Inc	Box 3086, Glendale Sta, Burbank	Cal
Engineered Equipment, Inc	1001 Linden Ave, Waterloo	Iowa
Erie Strayer Co	Erie	Pa
Fairbanks, Morse & Co	600 S Michigan Ave, Chicago 5	Ill
Howe Scale Co	Rutland	Vt
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 342	**470 S 10 E, Salt Lake City 2**	**Utah**
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
Nolan Co	120 Pennsylvania St, Bowerston	Ohio
Richardson Scale Co	Clifton	NJ
Thayer Scale	Pembroke	Mass
Thurman Scale Co	1939 Refugee Rd, Columbus	Ohio
Toledo Scale Dlv, Toledo Scale Corp	1112 Telegraph Rd, Toledo 12	Ohio
WEIGHING & CONTROLS, INC. SUB OF COMPUDYNE CORP., Adv Pg 347	**Industrial Park, E County Line Rd. Hatboro 10**	**Pa**
Western Conveyor Co	Box 357, Boise	Idah

SCIENTIFIC INSTRUMENTS–See LABORATORY & SCIENTIFIC INSTRUMENTS: CHEMICAL LAB. EQUIP.; METERS: GEOPHYSICAL INSTRUMENTS: SPECTROSCOPIC INSTRUMENTS: DRAFTING EQUIP.; SURVEYING EQUIP.

SCINTILLATION COUNTERS–See RADIATION DETECTORS

SCRAPERS–*DRAGLINE–See* BUCKETS–*DRAGLINE SCRAPER–SLUSHER; HOISTS–DRAGLINE SCRAPER-SLUSHER; EXCAVATORS–DRAGLINE TOWER*

SCRAPERS–*WHEELED–SELF-PROPELLED & TOWING (EARTH-MOVING)*

Allis Chalmers Mfg Co, Construction Machinery Div	1126 S 70 St, Milwaukee	Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318	**Peoria**	**Ill**
Clark Equipment Co, Construction Machinery Div	Box 599, Pipestone Rd, Benton Harbor	Mich
EUCLID DIV. GENERAL MOTORS CORP., Adv Pg 122	**Hudson**	**Ohio**
GREENVILLE STEEL CAR CO., Adv Pg 39	**Greenville**	**Pa**
LeTourneau Inc	2590 S MacArthur St, Longview	Tex
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65	**2301 N Adams St, Peoria**	**Ill**
Robbins Machine & Mfg Co	Oneonta	Ala

SCREEN CLOTH–See WIRE CLOTH

SCREEN ECCENTRICS & VIBRATORS–*Also See* VIBRATORS

Bird Machine Co	South Walpole	Mass
Cleveland Vibrator Co	2828 Clinton Ave, Cleveland 13	Ohio
Diamond Iron Works Div, Goodman Mfg Co	Halsted St. & 48 Pl, Chicago 9	Ill
Hack Engineering Co	124 Wazee Market, Denver	Colo
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Martin Engineering Co	Neponset	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Overstrom & Sons Inc	2213 W Mission Rd, Alhambra	Cal
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Rogers Iron Works Co	Joplin	Mo
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa

SCREEN HEATERS

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Derrick Mfg Co	590 Duke Rd, Buffalo 25	NY
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Overstrom & Sons Inc	2213 W Mission Rd, Alhambra	Cal
Screen Equipment Co, Inc	Box 46, Buffalo 25	NY
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio

SCREEN PLATES & SHEET

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave, Denver 4**	**Colo**
Chicago Perforating Co	2445 W 24th Pl, Chicago 8	Ill
Fairmont Machinery Co	Fairmont	W Va
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Laubenstein Mfg Co	422 S Third St, Ashland	Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
National Standard Co	Eight & Howard, Niles	Mich
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Taylor Wharton Div, Harsco Corp	High Bridge	NJ

SCREEN–*WIRE & BAR*

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Bixby-Zimmer Engr Co	961 Abingdon St, Galesburg	Ill
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
DORR OLIVER INC., Adv. Pgs. 8-9	**Nevamar Ln, Stamford**	**Conn**
HENDRICK MFG CO., Adv Pg 77	**Carbondale**	**Pa**
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Hoyt Wire Cloth Co	Box 1577, Lancaster	Pa
Iowa Mfg Co	916 16 St, NE, Cedar Rapids	Iowa
Irving Subway Grating Co, Inc	50-09 27th St, Long Island City 1	NY
Manganese Steel Forge Co	Richmond & Castor Ave, Philadelphia	Pa
National Standard Co	Eight & Howard, Niles	Mich
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Newark Wire Cloth Co	370 Verona Ave, Newark 4	NJ
Overstrom & Sons Inc	2213 W Mission Rd, Alhambra	Cal
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
U S STEEL CORP., Adv. Pgs. 2, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
VEDGE WIRE CORP., Adv Pg 328	**Gen St. & N.P.R.R., Wellington**	**Ohio**
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

SCREENS–*ELECTRICALLY HEATED*

ACKER DRILL CO. INC., Adv Pg 360	**Box 830, Scranton**	**Pa**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
DEISTER CONCENTRATOR CO. INC., Adv Pg 362	**903 Glasgow Ave, Ft Wayne**	**Ind**
Derrick Mfg Co	590 Duke Rd, Buffalo 25	NY
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Overstrom & Sons Inc	2213 W Mission Rd, Alhambra	Cal
Productive Equipment Corp	2926 W Lake St, Chicago 12	Ill
Screen Equipment Co, Inc	Box 46, Buffalo 25	NY
SimPLICITY ENGINEERING CO., Adv Pg 349	**Durand**	**Mich**
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Universal Vibrating Screen Co	Deane Blvd. & St Paul RR, Racine	Wis

SCREENS–*GRAVITY*

Bixby-Zimmer Engr Co	961 Abingdon St, Galesburg	Ill
Chicago Perforating Co	2445 W 24th Pl, Chicago 8	Ill
DORR OLIVER INC., Adv. Pgs. 8-9	**Nevamar Ln, Stamford**	**Conn**
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
HENDRICK MFG CO., Adv Pg 77	**Carbondale**	**Pa**
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
Laubenstein Mfg Co	422 S Third St, Ashland	Pa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Newark Wire Cloth Co	370 Verona Ave, Newark 4	NJ
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa
VEDGE WIRE CORP., Adv Pg 328	**Gen St. & N.P.R.R., Wellington**	**Ohio**

SCREENS–*REVOLVING (TROMMEL)*

CARD, C. S., IRON WORKS, Adv Pg 356	**2501 W 16th Ave, Denver 4**	**Colo**
Chicago Perforating Co	2445 W 24th Pl, Chicago 8	Ill
Davis Foundry & Machine Works	Old Furnace Rd, Rome	Ga
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Diamond Iron Works Div, Goodman Mfg Co	Halsted St. & 48 Pl, Chicago 9	Ill
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hack Engineering Co	124 Wazee Market, Denver	Colo
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
HENDRICK MFG CO., Adv Pg 77	**Carbondale**	**Pa**
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
Laubenstein Mfg Co	422 S Third St, Ashland	Pa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 320	**Hollidaysburg**	**Pa**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Newark Wire Cloth Co	370 Verona Ave, Newark 4	NJ
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Rogers Iron Works Co	Joplin	Mo
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr, Milwaukee 12	Wis
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa
Universal Road Machinery Co	Emerick St, Kingston	NY
VEDGE WIRE CORP., Adv Pg 328	**Gen St. & N.P.R.R., Wellington**	**Ohio**
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

SCREENS–*SHAKING & VIBRATING*

Ajax Flexible Coupling Co, Inc	Westfield	NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Bird Machine Co	South Walpole	Mass
Bonded Scale & Machine Co	38 Bellevue Ave, Columbus 7	Ohio
Carpco Research & Engineering, Inc	P O Box 3272, Jacksonville 6	Fla
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
Chicago Perforating Co	2445 W 24th Pl, Chicago 8	Ill
Cleveland Vibrator Co	2828 Clinton Ave, Cleveland 13	Ohio
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Crossley Machine Co	Mammoth & Bell Sts, Trenton	NJ
Davis Foundry & Machine Works	Old Furnace Rd, Rome	Ga
DEISTER CONCENTRATOR CO. INC., Adv Pg 362	**903 Glasgow Ave, Ft Wayne**	**Ind**
DEISTER MACHINE CO., Adv Pg 358	**1933 E Wayne St, Fort Wayne**	**Ind**
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Derrick Mfg Co	590 Rd, Buffalo 25	NY
Diamond Iron Works Div, Goodman Mfg Co	Halsted St. & 48 Pl, Chicago 9	Ill
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Drave Corp	Neville Island, Pittsburgh 25	Pa
Exalon Co	E Niagara St, Tonawanda	NY
Fairmont Machinery Co	Fairmont	W Va
Gilson Screen Co	110 Center St, Malenta	Ohio
Hack Engineering Co	124 Wazee Market, Denver	Colo
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
HENDRICK MFG CO., Adv Pg 77	**Carbondale**	**Pa**
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Industrial Engineering & Construction Co	1st Natl Bank Bldg, Fairmont	W Va
Iowa Mfg Co	916 16 St, NE, Cedar Rapids	Iowa
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
KENNEDY VAN SAUN MFG & ENG CORP., Adv Pg 129	**405 Park Ave, New York 22**	**NY**
Laubenstein Mfg Co	422 S Third St, Ashland	Pa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Martin Engineering Co	Neponset	Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
National Standard Co	Eight & Howard, Niles	Mich
Newark Wire Cloth Co	370 Verona Ave, Newark 4	NJ
NORDBERG MFG CO., Adv Pgs. 306-307, 308, 309	**3073 S Chase Ave, Milwaukee 1**	**Wis**
Overstrom & Sons Inc	2213 W Mission Rd, Alhambra	Cal
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Productive Equipment Corp	2926 W Lake St, Chicago 12	Ill
Ridge Equipment Co	Fallentimber	Pa
Screen Equipment Co, Inc	Box 46, Buffalo 25	NY
SimPLICITY ENGINEERING CO., Adv Pg 349	**Durand**	**Mich**
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr, Milwaukee 12	Wis
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
STURTEVANT MILL CO., Adv Pg 362	**101 Clayton St, Boston 22**	**Mass**
Sutton Steele & Steele Inc	1031 S Haskell St, Dallas 23	Tex
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo
Universal Engineering Corp	625 C Ave. NW, Cedar Rapids	Iowa
Universal Vibrating Screen Co	Deane Blvd. & St Paul RR, Racine	Wis
VEDGE WIRE CORP., Adv Pg 328	**Gen St. & N.P.R.R., Wellington**	**Ohio**
WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**

SCRUBBERS–*AIR & WASTE GAS–Also See* DUST COLLECTORS: GAS SEPARATION PROCESS EQUIPMENT

Aerotec Industries, Inc	Greenwich	Conn
AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave, Louisville 9**	**Ky**
Antipol Corp	407 Hill Arcade, Galesburg	Ill
BUELL ENGINEERING CO., Adv Pg 154	**123 William St. New York 38**	**NY**
Buffalo Forge Co	490 Broadway, Buffalo 5	NY
Chemical Construction Corp	320 Park Ave, New York 22	NY
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DUCON CO. INC., Adv Pg 158	**153 E Second St. Mineola**	**NY**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
The Johnson-March Corp	3018 Market St, Philadelphia 4	Pa
Oxy-Catalyst Inc	511 Old Lancaster Rd, Berwyn	Pa
Research-Cottrell Inc	Bound Brook	NJ
Sly, W. W., Mfg Co	Box 5939, Cleveland 1	Ohio
TREADWELL, M.R., CO. INC., Adv Pg 75	**148 Cedar St. New York 6**	**NY**
U S Stoneware Co	Akron 9	Ohio
WESTERN PRECIPITATION DIV. JOY MFG CO., Adv. Pgs. 67 & 338	**1000 W 9 St. Los Angeles 15**	**Cal**

SCRUBBERS–*ENGINE EXHAUST–See* ENGINE EXHAUST SCRUBBERS

SCRUBBERS & WASHERS–*MINERAL–Also See* AGITATORS–*WASHING PLANTS*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St. Milwaukee 1**	**Wis**
Davis Foundry & Machine Works	Old Furnace Rd, Rome	Ga
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
Eagle Iron Works	262 Holcomb Ave, Des Moines 4	Iowa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hack Engineering Co	124 Wazee Market, Denver	Colo
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 320	**Hollidaysburg**	**Pa**
MINE & SHELTER SUPPLY CO., Adv. Pgs. 322-323	**Box 9041, Denver 16**	**Colo**

MIXING EQUIPMENT CO., Adv Pg 135 ..... 234 Mt Read Blvd. Rochester 3 ..... NY
Pioneer Engineering, Div of Poor & Co, Inc ..... 3200 Como Ave. SE., Minneapolis 14 ... Minn
Rogers Iron Works Co ..... Joplin ..... Mo
Smith Engineering Works, Div of Barber-Greene ... 532 E Capitol Dr, Milwaukee 12 ..... Wis
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo
Universal Engineering Corp ..... 625 C Ave. NW, Cedar Rapids ..... Iowa
Universal Road Machinery Co ..... Emerick St, Kingston ..... NY

SELF-LOADING TRANSPORTS–See SCRAPERS; CARS–*MINE R.R.*; TRUCKS; LOADERS

SEPARATORS & CONCENTRATORS (ORE)–See *BELOW*; Also See AMALGAMATING PROCESS EQUIPMENT (*SPECIAL*); ASBESTOS MILLING EQUIPMENT (*SPECIAL*); CLASSIFIERS; CYANIDING; PROCESS EQUIPMENT (*SPECIAL*); DIAMOND CONCENTRATING EQUIPMENT (*SPECIAL*); FILTERS; FLOTATION MACHINES; GAS SEPARATION EQUIPMENT (*SPECIAL*); ION EXCHANGE EQUIPMENT (*SPECIAL*); KILNS; RETORTS AND DISTILLATION EQUIPMENT; SCREENS; SCRUBBERS; SOLVENT EXTRACTION EQUIPMENT (*SPECIAL*); THICKENERS

SEPARATORS (ORE) ELECTROSTATIC & HIGH TENSION
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352 4716 W Electric Ave. Milwaukee 46 .... Wis
Exolon Co ..... E Niagara St. Tonawanda ..... NY
Overstrom & Sons Inc ..... 2213 W Mission Rd. Alhambra ..... Cal
STEARNS MAGNETIC PRODUCTS, DIV OF
INDIANA GENERAL CORP., Adv Pg 156 ..... 635 S 28 St. Milwaukee 46 ..... Wis

SEPARATORS (ORE)–*HEAVY MEDIA TYPE–FOR RECOVERY OF MEDIA ALONE*–See HEAVY MEDIA RECOVERY UNITS
Derrick Mfg Co ..... 590 Duke Rd. Buffalo 25 ..... NY
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352 4716 W Electric Ave. Milwaukee 46 .... Wis
DORR OLIVER INC., Adv. Pgs. 8-9 ..... Havemeyer La. Stamford ..... Conn
Eagle Iron Works ..... 262 Holcomb Ave. Des Moines 4 ..... Iowa
HARDINGE CO. INC., Adv. Pgs. 340-341 ..... 240 Arch St. York ..... Pa
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Magnetic Engineering & Mfg Co ..... 852 Van Houten Ave. Clifton ..... NJ
MINE & SHELTER SUPPLY CO.,
Adv. Pgs. 322-323 ..... Box 9041, Denver 16 ..... Colo
Ore & Chemical Corp ..... 80 Broad St. New York ..... NY
Ridge Equipment Co ..... Fallentimber ..... Pa
Southwestern Engineering Co ..... 4800 Santa Fe Ave. Los Angeles 58 ... Cal
STEARNS MAGNETIC PRODUCTS, DIV OF
INDIANA GENERAL CORP., Adv Pg 156 ..... 635 S 28 St. Milwaukee 46 ..... Wis
STEARNS ROGER MFG CO., Adv Pg 291 ..... 660 Bannock St. Denver 17 ..... Colo
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY
Universal Road Machinery Co ..... Emerick St, Kingston ..... NY
Western Machinery Co, Wemco Div ..... 650 Fifth St. San Francisco 7 ..... Cal

SEPARATORS (ORE)–*JIG–DRY*
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY

SEPARATORS (ORE)–*JIG–WET*
DENVER EQUIPMENT CO., Adv Pg 76 ..... Box 5268, Denver 17 ..... Colo
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
GENERAL AMERICAN TRANSPORTATION CORP.,
Adv Pg 139 ..... 135 S LaSalle St. Chicago 3 Ill
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McLANAHAN CORP., Adv Pg 320 ..... Hollidaysburg ..... Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... 307 W Third St. Pittsburg ..... Kan
Meckum Engineering Inc ..... Dayton Rd. Ottawa Ill
STEPHENS-ADAMSON MFG CO., Adv Pg 164 .... 260 Ridgeway Ave. Aurora Ill
Western Machinery Co, Wemco Div ..... 650 Fifth St. San Francisco 7 ..... Cal

SEPARATORS (ORE)–*MAGNETIC–BELT & DRUM*
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
DINGS MAGNETIC SEPARATOR CO., Adv Pg 352 4716 W Electric Ave. Milwaukee 46 .... Wis
Dravo Corp ..... Neville Island, Pittsburgh 25 ..... Pa
ERIEZ MFG CO., Adv Pg 365 ..... 315 Huguet Dr. Erie ..... Pa
Infilco, Inc ..... 901 S Campbell Ave, Tucson ..... Ariz
Jeffrey Mfg Co ..... 886 N 4th St. Columbus 16 ..... Ohio
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Magnetic Engineering & Mfg Co ..... 852 Van Houten Ave, Clifton ..... NJ
STEARNS MAGNETIC PRODUCTS, DIV OF
INDIANA GENERAL CORP., Adv Pg 156 ..... 635 S 28 St. Milwaukee 46 ..... Wis
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY

SEPARATORS (ORE)–*SHAKING TABLE–DRY (AIR)*
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
Overstrom & Sons Inc ..... 2213 W Mission Rd. Alhambra ..... Cal
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc ..... 201 N Wells St. Chicago 6 Ill
Sutton Steele & Steele Inc ..... 1031 S Haskell St. Dallas 23 ..... Tex

SEPARATORS (ORE)–*SHAKING TABLE–WET*
Buntonite Co ..... 330 Passaic Ave. Nutley 10 ..... NJ
Cannon Concentrator ..... 1143 Sycamore St. Lakeland ..... Fla
Dagley Mfg Co ..... 1217 E Sixth St. Joplin ..... Mo
DEISTER MACHINE CO., Adv Pg 358 ..... 1933 E Wayne St. Fort Wayne ..... Ind
DENVER EQUIPMENT CO., Adv Pg 76 ..... Box 5268, Denver 17 ..... Colo
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
GENERAL AMERICAN TRANSPORTATION CORP.,
Adv Pg 139 ..... 135 S LaSalle St. Chicago 3 Ill
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... 307 W Third St. Pittsburg ..... Kan
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo

SEPARATORS (ORE)–*SLUICE (THROUGH) SPIRAL & SIMILAR FILM GRAVITY TYPES*
Carpco Research & Engineering, Inc ..... P O Box 3272, Jacksonville 6 ..... Fla
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-
HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... 82 Beaver St. New York ..... NY
Hack Engineering Co ..... 124 Wazee Market, Denver ..... Colo
Humphreys Engineering Co ..... 910 American Natl Bank Bldg, Denver 2 ..... Colo
McNALLY PITTSBURG MFG CORP., Adv Pg 137 ..... 307 W Third St. Pittsburg ..... Kan
Universal Dredge Mfg Co ..... 124 Wazee Market, Denver 4 ..... Colo

SHAFT MUCKING MACHINES–See LOADERS–*SPECIAL MINE SHAFT MUCKING*

SHEAVES–See *BELOW*; Also See BLOCKS

SHEAVES–*MINE HOIST*
AMERICAN BRAKE SHOE CO. AMERICAN
MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... 389 E 14 St. Chicago Heights Ill
American Pulley Co ..... 4200 Wissanicken Ave. Philadelphia 29 ..... Pa
BETHLEHEM STEEL CO., Adv Pg 46 ..... Bethlehem ..... Pa
CARD, C. S., IRON WORKS, Adv Pg 356 ..... 2501 W 16th Ave. Denver 4 ..... Colo
Coeur D'Alenes Co ..... Wallace ..... Idah
CONNELLSVILLE CORP., Adv Pg 342 ..... P O Box 677, Connellsville ..... Pa
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ... 333 Henry W Oliver Bldg. Pittsburgh 22 ..... Pa
Lake Shore Inc ..... P O Box 911, Iron Mountain ..... Mich
Lidgerwood Mfg Co ..... 7 Dey St. New York ..... NY
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357 ..... Box 1413, Lancaster ..... Pa
NAT'L MALLEABLE & STEEL CASTINGS,
CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310 ..... Phoenix ..... Ariz
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... 3073 S Chase Ave. Milwaukee 1 ..... Wis
Ogden Iron Works Co ..... 185 23 St. Ogden ..... Utah
Penn Machine Co ..... 905 H. K. Porter Bldg. Pittsburgh 19 ..... Pa
Penn Machine Co ..... 106 Station St. Johnstown ..... Pa
Penn Machine Co ..... P O Box 24, Huntington ..... W Va
Pittsburgh Gear Co ..... Neville Island, Pittsburgh 25 ..... Pa
Stroh Process Steel Co ..... Calif & Marvista Aves. Pittsburgh 12 ... Pa
Taylor Wharton Div, Harsco Corp ..... High Bridge ..... NJ
Tool Steel Gear & Pinion Co ..... 211 Township Ave. Cincinnati 16 ..... Ohio
Vulcan Iron Works Co ..... 2960 S Fox, Englewood ..... Colo
Washington Iron Works ..... 1500 6 Ave. S, Seattle 4 ..... Wash

SHOP EQUIPMENT–*MACHINE–FABRICATING & REPAIR–POWERED (LATHES–PRESSES–ETC.)–DOES NOT INCLUDE BLAST CLEANING EQUIPMENT; CONVEYOR BELTING VULCANIZERS; CRANES; DRILL BIT & STEEL FORGING HAMMERS; ELECTRIC CABLE SPLICERS & VULCANIZERS; FORGES; FURNACES; GRINDERS & BUFFERS; HOISTS; LIFT; METALLIZING EQUIPMENT; TIMBER FRAMING MACHINES; TOOLS–HAND & POWER; WELDING & CUTTING EQUIP.; STEAM CLEANING EQUIP.*
Baldwin-Lima-Hamilton Corp. Indl Eqpt Div ..... Philadelphia 42 ..... Pa
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16 ... 6 E 44th St. New York 17 ..... NY
Continental-Diamond Fibre Corp, Sub. Budd Co ... Newark ..... Del
Crossley Machine Co ..... Mammoth & Bell Sts. Trenton ..... NJ
Davis Foundry & Machine Works ..... Old Furnace Rd. Rome ..... Ga
Dominion Engineering Co. Ltd ..... Box 220, Montreal, Quebec ..... Can
Firth Sterling, Inc ..... 3113 Forbes Ave. Pittsburgh 30 ..... Pa
Hobart Bros Co ..... Main & Adams Sts. Troy 1 ..... Ohio
Ideal Industries, Inc ..... 1020 Park Ave. Sycamore Ill
Linde Co, Union Carbide Corp ..... 270 Park Ave. New York 17 ..... NY
LOGAN ENGINEERING CO., Adv Pg 361 ..... 4901 W Lawrence Ave. Chicago 30 Ill
McDOWELL CO. INC. THE WELLMAN
ENGINEERING CO., Adv Pg 366 ..... 113 St Clair Ave. NE, Cleveland 14 .... Ohio
Owatonna Tool Co ..... 655 Cedar St. Owatonna ..... Minn
Parker-Hannifin Corp ..... 17325 Euclid Ave, Cleveland 12 ..... Ohio
Proto Tool Div, Pendleton Tool Industries ..... 2209 Santa Fe Ave, Los Angeles 54 ... Cal
Ridge Tool Co ..... 400 Clark St. Elyria ..... Ohio
Rockwell Mfg Co ..... 400 N Lexington Ave. Pittsburgh 8 ..... Pa
Ryerson & Son, Inc ..... Box 8000A, Chicago 80 Ill
Simmons Boiler & Machine Co ..... 9011 Central Ave. Detroit 4 ..... Mich
Snap-on-Tools Corp ..... 8152-28 Ave. Kenosha ..... Wis
South Bend Lathe Inc ..... 425 E Madison St. South Bend 22 ..... Ind

SHOVELS–See EXCAVATORS–TOOLS

SHUTTLE CARS–See TRUCKS–*SHUTTLE CAR*

SIEVES–See *BELOW*; Also See SCREENS

SIEVES–*TESTING*
Bico, Inc ..... Box 3086, Glendale Sta. Burbank ..... Cal
Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
Gilson Screen Co ..... 110 Center St. Malinta ..... Ohio
Newark Wire Cloth Co ..... 370 Verona Ave, Newark 4 ..... NJ
Tyler, W. S., Co ..... 3615 Superior Ave, Cleveland 14 ..... Ohio

SIGNALS–See COMMUNICATIONS

SIGNS-POSTERS
Brady, W. H., Co ..... 727 Glendale Ave. Milwaukee 9 ..... Wis
FILTRATION ENGINEERS DIV. (FEINC) AMERICAN
MACHINE & METALS INC., Adv. Pgs. 292-293 ..... East Moline Ill
NATIONAL MINE SERVICE CO., Adv Pg 146 .... 2530 Koppers Bldg. Pittsburgh 19 ..... Pa

SINTERING EQUIPMENT (*SPECIAL*)–*DOES NOT INCLUDE FURNACES; KILNS; NODULIZING EQUIPMENT*
Dravo Corp ..... Neville Island, Pittsburgh 25 ..... Pa
McDOWELL CO. INC. THE WELLMAN
ENGINEERING CO., Adv Pg 366 ..... 113 St Clair Ave. NE, Cleveland 14 .... Ohio
NAT'L MALLEABLE & STEEL CASTINGS,
CAPITOL FOUNDRY DIV., Adv. Pgs. 69, 310 ..... Phoenix ..... Ariz
Stroh Process Steel Co ..... Calif & Marvista Aves. Pittsburgh 12 ... Pa
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY

SKIPHOISTS–See HOISTS
Lidgerwood Mfg Co ..... 7 Dey St. New York ..... NY
Link-Belt Co. Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
STEPHENS-ADAMSON MFG CO., Adv Pg 164 .... 260 Ridgeway Ave. Aurora Ill
Superior-Lidgerwood-Mundy Corp ..... 1101 John Ave. Superior ..... Wis
Vulcan Iron Works Co ..... 2960 S Fox, Englewood ..... Colo

SKIPS & CAGES (MINE HOIST)–*DOES NOT INCLUDE BUCKETS–HOISTING & SINKING*
CARD, C. S., IRON WORKS, Adv Pg 356 ..... 2501 W 16th Ave. Denver 4 ..... Colo
Coeur D'Alenes Co ..... Wallace ..... Idah
CONNELLSVILLE CORP., Adv Pg 342 ..... P O Box 677, Connellsville ..... Pa
Lake Shore Inc ..... P O Box 911, Iron Mountain ..... Mich
MACHINERY CENTER, INC., Adv Pg 355 ..... 1201 S 6th West, Salt Lake City 10 .... Utah
MAYO TUNNEL & MINE EQUIPMENT, Adv Pg 357 ..... Box 1413, Lancaster ..... Pa
NATIONAL IRON CO., Adv Pg 360 ..... Ramsey St. & 50 Ave. W, Duluth 7 .... Minn
Nolan Co ..... 120 Pennsylvania St. Bowerston ..... Ohio
Ogden Iron Works Co ..... 185 23 St. Ogden ..... Utah
Owen Bucket Co ..... 6001 Breakwater Ave. Cleveland 2 ..... Ohio
Roberts & Schaefer Co Div, Thompson-Starrett Co, Inc ..... 201 N Wells St. Chicago 6 Ill
Vulcan Iron Works Co ..... 2960 S Fox, Englewood ..... Colo

SLUSHERS–See BUCKETS–*DRAGLINE SCRAPER-SLUSHER*; HOISTS–*DRAGLINE SCRAPER-SLUSHER*; EXCAVATORS

SOLENOIDS–*ELECTRIC*
Allen-Bradley Co ..... 136 Greenfield Ave. Milwaukee 4 ..... Wis
Automatic Switch Co ..... Hanover Rd., Florham Park ..... NJ
Bivco, Inc ..... Box 2646, Terminal Annex, Spokane 2 .. Wash
Cutler-Hammer, Inc ..... 237 N 12 St. Milwaukee 1 ..... Wis
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... Schenectady 5 ..... NY
Guyan Machinery Co ..... 755 Stratton St. Logan ..... W Va
Vickers Inc, Electric Products Div ..... 1815 Locust St. St Louis 3 ..... Mo

SOLVENT EXTRACTION PROCESS EQUIPMENT (*SPECIAL*)–*DOES NOT INCLUDE STANDARD AUXILIARY EQUIPMENT*–Also See ION EXCHANGE; SOLVENT EXTRACTION; CYANIDING; AMALGAMATING; ELECTROLYTIC
Bird Machine Co ..... South Walpole ..... Mass
Chemical Separations Corp ..... Box 1031, Oak Ridge ..... Tenn
DORR OLIVER INC., Adv. Pgs. 8-9 ..... Havemeyer La. Stamford ..... Conn
MIXING EQUIPMENT CO., Adv Pg 135 ..... 234 Mt Read Blvd. Rochester 3 ..... NY
STEARNS ROGER MFG CO., Adv Pg 291 ..... 660 Bannock St. Denver 17 ..... Colo
TREADWELL, M.H., CO. INC., Adv Pg 75 ..... 140 Cedar St. New York 6 ..... NY
WICKWIRE SPENCER STEEL DIV. COLORADO
FUEL & IRON CORP., Adv. Pgs. 32-33 ..... 575 Madison Ave. New York 22 ..... NY

SPECTROSCOPIC INSTRUMENTS
Bausch & Lomb Inc ..... 83761 Bausch St. Rochester 2 ..... NY
Beckman Instruments, Inc. Scientific & Process Instruments Div ..... 2500 Harbor Blvd. Fullerton ..... Cal
Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
GENERAL ELECTRIC CO. APPARATUS SALES,
Adv. Pgs. 74, 167, 304 ..... Schenectady 5 ..... NY

SPEED REDUCERS & INCREASERS–See DRIVES

SPROCKETS–See GEARS

STACKERS–See CONVEYORS; *CRANES*

STEAM CLEANING EQUIPMENT
Clayton Mfg Co ..... Box 550, El Monte ..... Cal
Graver Water Conditioning Co, Union Tank Car Co, Div ..... 216 W 14 St. New York 11 ..... NY

STEEL (PLATES–SHAPES–ETC.)–*DOES NOT INCLUDE BUILDING PREFAB; CASTINGS; DRILL STEEL; FORGINGS; FENCING; MINE SUPPORTS; PIPE; SCREEN; TANKS; WIRE*
AMERICAN BRAKE SHOE CO. AMERICAN
MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... 389 E 14 St. Chicago Heights Ill
American Steel & Wire Div, U.S. Steel Corp ..... 614 Superior NW, Cleveland 13 ..... Ohio
Armco Div, Armco Steel Corp ..... 703 Curtis St. Middletown ..... Ohio
BETHLEHEM STEEL CO., Adv Pg 46 ..... Bethlehem ..... Pa
Colorado Fuel & Iron Corp ..... 575 Madison Ave. New York 22 ..... NY
COLORADO FUEL & IRON CORP.,
Adv. Pgs. 32-33 ..... Continental Oil Bldg. Denver 2 ..... Colo
Columbia-Geneva Steel Div, U.S. Steel Corp ..... 120 Montgomery St. San Francisco 6 ... Cal
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 343 ..... P O Box 88, Pittsburgh 30 ..... Pa
Engelhard Industries, Inc ..... 113 Astor St. Newark ..... NJ
Foster, L. B., Co ..... Box 1647, Pittsburgh 30 ..... Pa
Jones & Laughlin Steel Corp ..... 3 Gateway Center, Pittsburgh 30 ..... Pa
Lukens Steel Co ..... Coatesville ..... Pa
Metal Goods Corp ..... 8800 Page Blvd. St Louis 14 ..... Mo
National Tube Div, U.S. Steel Corp ..... 525 William Penn Pl. Pittsburgh ..... Pa
Pattin Mfg Co, Div of Eastern Co ..... Box 659, Marietta ..... Ohio
REPUBLIC STEEL CORP., Adv Pg 161 ..... Republic Bldg. Cleveland 1 ..... Ohio
The Rockiron Co, Ltd ..... P O Box 1089, Sudbury ..... Ont
Ryerson & Son, Inc ..... Box 8000A, Chicago 80 Ill
Adv Pg 66 ..... Sheffield Sta. Kansas City 25 ..... Mo
U S STEEL CORP., Adv. Pgs. 12, 280 ..... 525 Wm Penn Pl. Pittsburgh 30 ..... Pa

West Virginia Works, Conners Steel Div.		
H. K. Porter Co, Inc	Box 118, Huntington 6	W Va
VICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**
Alan Wood Steel Co	Conshohocken	Pa
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

STEEL—ALLOY (PLATES—SHAPES—ETC.)—DOES NOT INCLUDE CASTINGS; DRILL STEEL; FORGINGS; MINE SUPPORTS; PIPE; SCREENS; TANKS; WIRE—Also See LININGS

AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St. Chicago Heights**	**Ill**
American Steel & Wire Div. U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Armco Div. Armco Steel Corp	703 Curtis St. Middletown	Ohio
Atlas Steels, Ltd	Welland, Ontario	Cal
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Columbia-Geneva Steel Div. U.S. Steel Corp	120 Montgomery St. San Francisco 6	Cal
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 143	**P O Box 88, Pittsburgh 30**	**Pa**
Haynes Stellite Co. Div. Union Carbide Corp	Kokomo	Ind
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Lukens Steel Co	Coatesville	Pa
Manganese Steel Forge Co	Richmond & Castor Ave. Philadelphia	Pa
Metal Goods Corp	6800 Page Blvd. St Louis 14	Mo
National Tube Div. U.S. Steel Corp	525 William Penn Pl. Pittsburgh	Pa
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg. Cleveland 1**	**Ohio**
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
SHEFFIELD DIV. ARMCO STEEL CORP., Adv Pg 66	**Sheffield Sts. Kansas City 25**	**Mo**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
VICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**575 Madison Ave. New York 22**	**NY**
Alan Wood Steel Co	Conshohocken	Pa
Youngstown Sheet & Tube Co	Box 900, Youngstown 1	Ohio

STEEL FABRICATORS—See CONTRACTORS

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Commercial Shearing & Stamping Co	Dept. EMJ-MG, 1775 Logan Ave, Youngstown	Ohio
Dresser-Ideco Co	975 Michigan Ave. Columbus 8	Ohio
Enterprise Wheel & Car Corp	Bristol	Va
Fairmont Machinery Co	Fairmont	W Va
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Irwin Sensenich Corp	Box 311, Irwin	Pa
Lakeside Bridge & Steel Co	5306 N 33 St. Milwaukee 9	Wis
Mechum Engineering Inc	Dayton Rd. Ottawa	Ill
Ogden Iron Works Co	185 23 St. Ogden	Utah
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Simmons Boiler & Machine Co	9011 Central Ave. Detroit 4	Mich
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
SPANG & CO., Adv Pg 230	**143 Etna St. Butler**	**Pa**
Standard Steel Corp	5060 Boyle Ave. Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**268 Ridgeway Ave. Aurora**	**Ill**
STURTEVANT MILL CO., Adv Pg 242	**101 Clayton St. Boston 22**	**Mass**
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
Western Conveyor Co	Box 357, Boise	Idah
Whiting Corp	157 & Lathrop, Harvey	Ill

STEEL MINE SUPPORTS & CIRCULAR SETS—See MINE SUPPORTS

STEEL—STAINLESS (PLATES—SHAPES—ETC.)—DOES NOT INCLUDE CASTINGS; FORGINGS; MINE SUPPORTS; PIPE; SCREENS; TANKS; WIRE

Allegheny Ludlum Steel Corp	Oliver Bldg, Pittsburgh 22	Pa
American Steel & Wire Div. U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Armco Div. Armco Steel Corp	703 Curtis St. Middletown	Ohio
Atlas Steels, Ltd	Welland, Ontario	Can
Chase Brass & Copper Co	236 Grand St. Waterbury 20	Conn
Columbia-Geneva Steel Div. U.S. Steel Corp	120 Montgomery St. San Francisco 6	Cal
CRUCIBLE STEEL CO OF AMERICA, Adv Pg 143	**P O Box 88, Pittsburgh 30**	**Pa**
Metal Goods Corp	6800 Page Blvd. St Louis 14	Mo
National Tube Div. U.S. Steel Corp	525 William Penn Pl. Pittsburgh	Pa
REPUBLIC STEEL CORP., Adv Pg 161	**Republic Bldg. Cleveland 1**	**Ohio**
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Standard Steel Corp	5060 Boyle Ave. Los Angeles 58	Cal
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**

STOWERS—See CONCRETE PUMPS & PLACERS

STUD DRIVERS

Remington Arms Co, Inc	939 Barnum Ave. Bridgeport 2	Conn

SULPHER WELL EQUIPMENT—See SALT & SULPHUR

SURVEYING EQUIPMENT & SUPPLIES—Also See DRAFTING EQUIPMENT & SUPPLIES; TRANSITS—POCKET

AGA Corp of America	P O Box 447, South Plainfield	NJ
American Paulinn System	1524 S Flower St. Los Angeles 15	Cal
BOULDER SCIENTIFIC, Adv Pg 325	**250 Pearl St. Boulder**	**Colo**
Geo-Optic & Paper Corp	149 Church St. New York 7	NY
Geophysical Instrument & Supply	1616 Broadway, Denver 2	Colo
Gurley, W. & L. E.	514 Fulton St. Troy	NY
Kern Instruments, Inc	P O Box 727, White Plains	NY
Wallace & Tiernan Inc	Belleville 9	NJ
Warren-Knight Co	136 N 12 St. Philadelphia 7	Pa
White, David, Instruments Realist Inc	N93 W 16288 Megal Dr. Menomonee Falls	Wis
WILD HEERBRUGG INSTRUMENTS, INC., Adv Pg 299	**Main & Covert Sts. Port Washington**	**NY**

TABLES—See SEPARATORS & CONCENTRATORS

TACHOMETERS—See METERS—SPEED

TANK LEVEL INDICATORS—See BIN & TANK LEVEL INDICATORS

TANKS—EPOXY

Black, Sivalls & Bryson, Inc	7500 E 12th St. Kansas City 26	Mo

TANKS—LINED—See BELOW; Also See COATINGS; LININGS

Arrow Tank Co	16 Barnett St. Buffalo 15	NY
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Enterprise Wheel & Car Corp	Bristol	Va
Galigher Co	Box 209, Salt Lake City 10	Utah
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hauser-Stander Tank Co	4820 Spring Grove Ave. Cincinnati 32	Ohio
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**

TANKS—LINED—CERAMIC—CONCRETE—GLASS—ETC.

Butler Mfg Co	7400 E 13 St. Kansas City 26	Mo
Galigher Co	Box 209, Salt Lake City 10	Utah
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S Stoneware Co	Akron 9	Ohio

TANKS—LINED—PLASTIC—RUBBER—ETC.

Arrow Tank Co	16 Barnett St. Buffalo 15	NY
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Galigher Co	Box 209, Salt Lake City 10	Utah
Gates Engineering Co	100 S West St. Wilmington 99	Del
Gates Rubber Co	999 S Broadway, Denver 17	Colo
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Goodall Rubber Co	Whitehead Rd. Trenton	NJ
GOODRICH, B.F., INDUSTRIAL PRODUCTS CO., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
GOODYEAR TIRE & RUBBER CO., Adv Pg 11	**1144 E Market St. Akron 16**	**Ohio**
Hauser-Stander Tank Co	4820 Spring Grove Ave. Cincinnati 32	Ohio
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Luzerne Rubber Co	Whitehead & Dewey Sts. Trenton 7	NJ
Mercer Rubber Co	136 Mercer St. Trenton 90	NJ
Ogden Iron Works Co	185 23 St. Ogden	Utah
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
U S Stoneware Co	Akron 9	Ohio

TANKS—LINED—SPECIAL METAL

Arrow Tank Co	16 Barnett St. Buffalo 15	NY
Enterprise Wheel & Car Corp	Bristol	Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Hauser-Stander Tank Co	4820 Spring Grove Ave, Cincinnati 32	Ohio
Ionics Inc	152 Sixth St. Cambridge 42	Mass
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Wheeler, C. H., Mfg Co	19th & Lehigh Ave. Philadelphia 32	Pa

TANKS—STEEL—Also See BINS

BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Butler Mfg Co	7400 E 13 St. Kansas City 26	Mo
Chicago Bridge & Iron Co	332 S Michigan Ave. Chicago 4	Ill
Cochrane Div. Crane Co	17th St. below Allegheny Ave. Phila 32	Pa
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Engineered Equipment, Inc	1001 Linden Ave. Waterloo	Iowa
Enterprise Wheel & Car Corp	Bristol	Va
Fairmont Machinery Co	Fairmont	W Va
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Industrial Engineering & Construction Co	1st Natl Bank Bldg. Fairmont	W Va
Keeler, E., Co	238 West St. Williamsport 3	Pa
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Ogden Iron Works Co	185 23 St. Ogden	Utah
The Rockiron Co. Ltd	P O Box 1089, Sudbury	Ont
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Simmons Boiler & Machine Co	9011 Central Ave. Detroit 4	Mich
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**

TANKS—WOOD—Also See BINS

Arrow Tank Co	16 Barnett St. Buffalo 15	NY
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Fluor Products Co	Box 1267, Santa Rosa	Cal
Pacific Wood Tank Div. Sawers Forest Prods Inc	Box 188, Healdsburg	Cal

TANKS & VESSELS—PRESSURE (INCLUDING AUTOCLAVES—ETC)

ACF Industries, Inc. American Car & Foundry Div	750 Third Ave. New York 17	NY
Baldwin-Lima-Hamilton Corp. Indl Equi Div	Philadelphia 42	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Chicago Bridge & Iron Co	332 S Michigan Ave. Chicago 4	Ill
Combustion Engineering, Inc	200 Madison Ave. New York 16	NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Keeler, E., Co	238 West St. Williamsport 3	Pa
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Ogden Iron Works Co	185 23 St. Ogden	Utah
Pacific Coast Engineering Co	Oak & Clement Sts. Alameda	Cal
Simmons Boiler & Machine Co	9011 Central Ave. Detroit 4	Mich
Southwestern Engineering Co	4800 Santa Fe Ave. Los Angeles 58	Cal
TREADWELL, M.H., CO. INC., Adv Pg 75	**140 Cedar St. New York 6**	**NY**
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
Westinghouse Air Brake Co. Ind Products Div	P O Box 36, Wilmerding	Pa
Wheeler, C. H., Mfg Co	19th & Lehigh Ave. Philadelphia 32	Pa

TARPAULINS & TENTING

Bemis Bros. Bag Co	408 Pine St. St Louis 2	Mo
Daniels, C. R., Inc	Daniels	Md

TELEPHONES—See COMMUNICATIONS

TELEVISION—See COMMUNICATIONS

THERMOMETERS & THERMOCOUPLES—See METER—TEMPERATURE

THICKENERS—Also See CLASSIFIERS; FILTERS; SEPARATORS; SCREENS

Bird Machine Co	South Walpole	Mass
Burtonite Co	330 Passaic Ave. Nutley 10	NJ
Dagley Mfg Co	1217 E Sixth St. Joplin	Mo
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St. New York**	**NY**
DORR OLIVER INC., Adv. Pgs. 8-9	**Stamford Ln. Stamford**	**Conn**
EIMCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Fluor Products Co	Box 1267, Santa Rosa	Cal
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St. Chicago 3**	**Ill**
Graver Water Conditioning Co. Union Tank Car Co, Div	216 W 14 St. New York 11	NY
HARDINGE CO. INC., Adv. Pgs. 340-341	**240 Arch St. York**	**Pa**
Infilco, Inc	901 S Campbell Ave. Tucson	Ariz
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Morse Bros Machinery Co	2900 Brighton Blvd. Denver	Colo
Roberts & Schaefer Co Div. Thompson-Starrett Co, Inc	201 N Wells St. Chicago 6	Ill

TIMBER CONNECTORS—SPECIAL—DOES NOT INCLUDE FASTENERS

TIMBER—FRAMING MACHINES

STEARNS ROGER MFG CO., Adv Pg 291	**660 Bannock St. Denver 17**	**Colo**

TIMBER PRESERVATIVES

Allied Chemical Corp. Solvay Process Div	61 Broadway, New York 6	NY
Carbolineum Wood Preserving Co	6683 N 40th St. Milwaukee 9	Wis
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Osmose Wood Preserving Co	980 Ellicott St. Buffalo 9	NY
Wood Preservine Div Koppers Co, Inc	Koppers Bldg, Pittsburgh 19	Pa

TIRES & TUBES

Esso Standard Div. Humble Oil & Refining Co	15 W 51 St. New York 19	NY
FIRESTONE TIRE & RUBBER CO., Adv Pg 58	**1200 Firestone Pkwy. Akron 17**	**Ohio**
Gates Rubber Co	999 S Broadway, Denver 17	Colo
General Tire & Rubber Co	1708 Englewood Ave. Akron	Ohio
GOODRICH, B.F. CO. TRUCK & BUS TIRE DEPT., Adv Pg 3	**500 S Main St. Akron 18**	**Ohio**
Gulf Oil Corp. Dept. DM	Box 2140, Houston 1	Tex
Kelly-Springfield Tire Co	Box 300, Cumberland	Md
Seiberling Rubber Co	Akron 9	Ohio
U S RUBBER CO., Adv. Pgs. 187, 189	**1230 Ave of the Americas, New York 20**	**NY**
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY

TOOLS—HAND & HAND-HELD POWER TOOLS—DOES NOT INCLUDE CAR DERAILERS & RERAILERS; CAR MOVERS—HAND; HOISTS—LIFT—HAND CHAIN—JACKS; RAIL BENDERS—TRACK GAGE-RODS & LEVELS; SHOP EQUIPMENT—POWERED (LATHES—ETC.); LUBRICATING EQUIPMENT; CAR WHEEL & GEAR PULLERS; CONCRETE PLACERS; KILN & INDUSTRIAL GUNS; STUD DRIVERS; RAIL DRILLS & PUNCHES; TIMBERING MACHINES; GEOLOGIST'S EQUIP.; WELDING & CUTTING EQUIP.; BURNERS; INSTRUMENTS; METERS AND GAGES

Alemite Div. Stewart-Warner Corp	1826 Diversey Pkwy. Chicago 14	Ill
Ampco Metal, Inc	1739 S 38 St. Milwaukee 1	Wis
Armstrong, Bray & Co	5364 Northwest Hwy. Chicago 30	Ill
The Beryllium Corp	P O Box 1462, Reading	Pa
Black & Decker Mfg Co	600 E Pennsylvania Ave. Towson	Md
Black's Machine Shop	169 Willow St. Bishop	Cal
BRUNNER & LAY, INC., Adv Pg 254	**9300 W King St. Franklin Park**	**Ill**
Brunner & Lay-Eastern, Inc	2514-16 Cumberland St. Phila 25	Pa
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St. New York 17**	**NY**
Firth Sterling, Inc	3113 Forbes Ave. Pittsburgh 30	Pa
Frank, M. K.	480 Lexington Ave. New York 17	NY
Gray & Co, Inc	60-11 Ave. NE, Minneapolis 13	Minn
Greene, Tweed & Co	North Wales	Pa
Homelite, Div of Textron Inc	75 Riverdale Ave. Port Chester	NY
Ideal Industries, Inc	1020 Park Ave. Sycamore	Ill
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
Linde Co. Union Carbide Corp	270 Park Ave. New York 17	NY
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Owatonna Tool Co	655 Cedar St. Owatonna	Minn
Parker-Hannifin Corp	17325 Euclid Ave. Cleveland 12	Ohio
Porter-Cable Machine Co	700 Marcellus St. Syracuse 4	NY
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St. Pittsburgh 19**	**Pa**
Proto Tool Div. Pendleton Tool Industries	2209 Santa Fe Ave. Los Angeles 54	Cal
Remington Arms Co, Inc	939 Barnum Ave. Bridgeport 2	Conn
Rexarc Inc, Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio
Ridge Tool Co	400 Clark St. Elyria	Ohio
Rockwell Mfg Co	400 N Lexington Ave. Pittsburgh 8	Pa
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill

Snap-on-Tools Corp ..... 8152-28 Ave, Kenosha ..... Wis
Thor Power Tool Co ..... 175 N State St, Aurora Ill
VICTAULIC CO OF AMERICA, Adv Pg 334 ..... **P O Box 5091E, Elizabeth** ..... **NJ**

TOOLS–*POWER–See ABOVE OR* SHOP EQUIPMENT

TORQUE CONVERTERS–See DRIVES

TOWERS–*EXTENSIBLE & MOBILE–See* BOOMS

TRACK–*See BELOW; Also See* RAIL

TRACK ADZING MACHINE
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY

TRACK BALLAST REMOVAL AND CLEANING MACHINES
ATHEY PRODUCTS CORP., Adv Pg 171 ..... **5631 W 65 St, Chicago 38** ..... **Ill**
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
Pettibone Mulliken Corp ..... 4710 W Division St, Chicago 51 Ill

TRACK–CLEANING MACHINES
AMERICAN MINE DOOR CO., Adv Pg 324 ..... **2839 Dreher Ave, SW, Canton 6** ..... **Ohio**
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
GOODYEAR TIRE & RUBBER CO., Adv Pg 11 ..... **1144 E Market St, Akron 16** ..... **Ohio**
NORDBERG MFG CO., Adv Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**

Pettibone Mulliken Corp ..... 4710 W Division St, Chicago 51 Ill

TRACK GAGE–RODS & LEVELS
BETHLEHEM STEEL CO., Adv Pg 46 ..... **Bethlehem** ..... **Pa**
Foster, L. B., Co ..... Box 1547, Pittsburgh 30 ..... Pa
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY

TRACK GAGING AND LINING MACHINES
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY

TRACK GANG TAMPERS
Fletcher, J. H. & Co ..... 707 W 7th St, Huntington ..... W Va
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY

TRACK POWER JACKS AND WRENCHES
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 ..... **11 Broadway, New York 4** ..... **NY**
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

TRACK SHIFTER–*LAYING & OTHER MACHINES*
Fletcher, J. H. & Co ..... 707 W 7th St, Huntington ..... W Va
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
NORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309 ..... **3073 S Chase Ave, Milwaukee 1** ..... **Wis**
Scheidt Bantam Co ..... 221 Park St, Waverly ..... Iowa
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

TRACK SPIKE PULLERS AND HAMMERS
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277 ..... **11 Broadway, New York 4** ..... **NY**

TRACK SURFACERS
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
Rexarc Inc, Sight Feed Generator Div ..... P O Box 47, West Alexandria 2 ..... Ohio
Templeton, Kenly & Co ..... 16th & Gardner Rd, Broadview Ill

TRACK TIE PULLERS AND INSERTERS
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY

TRACTORS, CRAWLER
Allis Chalmers Mfg Co, Construction Machinery Div ..... 1126 S 70 St, Milwaukee ..... Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
John Deere ..... 3300 River Dr, Moline Ill
DIESEL ENERGY CORP, U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
EIMCO CORP., Adv Pg 335 ..... **501 W 6th South St, Salt Lake City 10** ..... **Utah**
EUCLID DIV, GENERAL MOTORS CORP., Adv Pg 122 ..... **Hudson** ..... **Ohio**
Hough, Frank G., Co ..... 726 Seventh St, Libertyville Ill
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
Oliver Corp ..... 400 W Madison, Chicago 6 Ill

TRACTORS–*WHEELED–DOES NOT INCLUDE TRACK TRACTORS; Also See* CAR MOVERS
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
John Deere ..... 3300 River Dr, Moline Ill
DIESEL ENERGY CORP, U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
FWD Corp ..... 12 St, Clintonville ..... Wis
Hough, Frank G., Co ..... 726 Seventh St, Libertyville Ill
Kersey Mfg Co, Inc ..... Box 151, Blufield ..... Va
LeTourneau Inc ..... 2390 S MacArthur St, Longview ..... Tex
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65 ..... **2301 N Adams St, Peoria** ..... **Ill**
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
Oliver Corp ..... 400 W Madison, Chicago 6 Ill
Robbins Machine & Mfg Co ..... Oneonta ..... Ala
Walter Motor Truck Co ..... School Rd, Voorheesville ..... NY
KW-Westfall Co ..... 437 N Columbia Blvd, Portland 17 ..... Ore

TRACTOR ATTACHMENTS–*Also See* LOADERS
Allis Chalmers Mfg Co, Construction Machinery Div ..... 1126 S 70 St, Milwaukee ..... Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... **389 E 14 St, Chicago Heights** ..... **Ill**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
Colorado Fuel & Iron Corp ..... 575 Madison Ave, New York 22 ..... NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **Continental Oil Bldg, Denver** ..... **Colo**
John Deere ..... 3300 River Dr, Moline Ill
EIMCO CORP., Adv Pg 335 ..... **501 W 6th South St, Salt Lake City 10** ..... **Utah**
Gar Wood Industries, Inc ..... Wayne ..... Mich
GREENVILLE STEEL CAR CO., Adv Pg 39 ..... **Greenville** ..... **Pa**
Hough, Frank G., Co ..... 726 Seventh St, Libertyville Ill
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Manganese Steel Forge Co ..... Richmond & Castor Ave, Philadelphia ..... Pa
Midwestern Engine & Equipment Co ..... Box 1886, Tulsa ..... Okla
Oliver Corp ..... 400 W Madison, Chicago 6 Ill
KW-Westfall Co ..... 437 N Columbia Blvd, Portland 17 ..... Ore

TRACTOR & EARTHMOVING EQUIPMENT WEAR-REPLACEMENT PARTS
Allis Chalmers Mfg Co, Construction Machinery Div ..... 1126 S 70 St, Milwaukee ..... Wis
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149 ..... **389 E 14 St, Chicago Heights** ..... **Ill**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
Colorado Fuel & Iron Corp ..... 575 Madison Ave, New York 22 ..... NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33 ..... **Continental Oil Bldg, Denver 2** ..... **Colo**
EIMCO CORP., Adv Pg 335 ..... **501 W 6th South St, Salt Lake City 10** ..... **Utah**
Frog, Switch & Mfg Co ..... Carlisle ..... Pa
Gar Wood Industries, Inc ..... Wayne ..... Mich
Marquette Manufacturing Co, Div of Marquette Corp ..... 307 E Hennepin Ave, Minneapolis 14 ..... Minn
Oliver Corp ..... 400 W Madison, Chicago 6 Ill
Pettibone Mulliken Corp ..... 4710 W Division St, Chicago 51 Ill
Robbins Machine & Mfg Co ..... Oneonta ..... Ala
Sorel Steel Foundries Ltd ..... 1405 Peel St, Montreal 2, P.Q. ..... Can
Taylor Wharton Div, Harsco Corp ..... High Bridge ..... NJ

TRAILERS & WAGONS FOR MOTOR-TRUCK & TRACTOR–*Also See* SCRAPERS: TRUCKS & TRAILERS–*SPECIAL SELF-LOADING*
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
ATHEY PRODUCTS CORP., Adv Pg 171 ..... **5631 W 65 St, Chicago 38** ..... **Ill**
CATERPILLAR TRACTOR CO., Adv. Pgs. 36-37, 44, 318 ..... **Peoria** ..... **Ill**
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
Enterprise Wheel & Car Corp ..... Bristol ..... Va
Gar Wood Industries, Inc ..... Wayne ..... Mich
Heil Co—TEC Div ..... 1285 W 70 St, Cleveland 2 ..... Ohio

TRAMP IRON DETECTORS
Assa Electric, Inc ..... 500 Fifth Ave, New York 36 ..... NY
INDUSTRIAL PHYSICS & ELECTRONICS CO., Adv Pg 362 ..... **470 S 10 E, Salt Lake City 2** ..... **Utah**
McCulloch Corp, Los Angeles Div ..... 6101 W Century Blvd, Los Angeles 45 ..... Cal

TRANSITS–*POCKET*
AINSWORTH, WILLIAM, & SONS, Adv Pg 347 ..... **2151 Lawrence St, Denver 5** ..... **Colo**
Geo-Optic & Paper Corp ..... 149 Church St, New York 7 ..... NY
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Warren-Knight Co ..... 136 N 12 St, Philadelphia 7 ..... Pa
White, David, Instruments Realist Inc ..... 1493 W 16288 Megal Dr, Menomonee Falls ..... Wis

TRANSMISSIONS–See DRIVES

TRAPS–See PIPELINE TRAPS

TROLLEY (ELECTRICAL HAULAGE) ACCESSORIES–See ELECTRIC TROLLEY ACCESSORIES

TRUCK–*TRACTOR & TRAILER ACCESSORIES–Also See* ENGINE ACCESSORIES: ELECTRIC
Caster Mold & Machine Co ..... 1079 E & J St, Barberton ..... Ohio
Chrysler Corp, Dodge Truck Div ..... 7900 Joseph Campau Ave, Detroit ..... Mich
Heil Co—TEC Div ..... 1285 W 70 St, Cleveland 2 ..... Ohio

TRUCK & TRAILER BODIES
ATHEY PRODUCTS CORP., Adv Pg 171 ..... **5631 W 65 St, Chicago 38** ..... **Ill**
DIFFERENTIAL CO., Adv Pg 350 ..... **Findlay** ..... **Ohio**
Differential Steel Car Co ..... Findlay ..... Ohio
Enterprise Wheel & Car Corp ..... Bristol ..... Va
Galion Allsteel Body Co ..... 605 S Market St, Galion ..... Ohio
Gar Wood Industries, Inc ..... Wayne ..... Mich
Heil Co—TEC Div ..... 1285 W 70 St, Cleveland 2 ..... Ohio
Hercules Steel Products Co ..... 500 Sherman St, Galion ..... Ohio
KW-DART TRUCK CO., Adv Pg 157 ..... **1301 N Manchester Trfwy, Kansas City 20** ..... **Mo**

TRUCK & TRAILER DUMPING DEVICES–See CAR & TRUCK DUMPING DEVICES

TRUCK TRAILERS–See TRAILERS

TRUCKS (MOTOR) & TRUCK TRACTORS–*Also See BELOW AND* SCRAPERS: TRAILERS
Autocar Div, White Motor Co ..... Lancaster Pike, Exton ..... Pa
Chrysler Corp, Dodge Truck Div ..... 7900 Joseph Campau Ave, Detroit ..... Mich
DIESEL ENERGY CORP, U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339 ..... **82 Beaver St, New York** ..... **NY**
DIFFERENTIAL CO., Adv Pg 350 ..... **Findlay** ..... **Ohio**
Differential Steel Car Co ..... Findlay ..... Ohio
FWD Corp ..... 12 St, Clintonville ..... Wis
FORD MOTOR CO., Adv. Pgs. 14-15 ..... **Box 658, Dearborn** ..... **Mich**
INTERNATIONAL HARVESTER CO. MOTOR TRUCK DIV., Adv. Pgs. 40-41-42-43 ..... **180 N Michigan Ave, Chicago 1** ..... **Ill**
KW-DART TRUCK CO., Adv Pg 157 ..... **1301 N Manchester Trfwy, Kansas City 20** ..... **Mo**
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Lansing Div, White Motor Co ..... 1331 S Washington St, Lansing 20 ..... Mich
Oshkosh Motor Truck Inc ..... 2300 Oregon St, Oshkosh ..... Wis
Walter Motor Truck Co ..... School Rd, Voorheesville ..... NY

TRUCKS–*LIFT-FORK & PLATFORM*
ALLIS-CHALMERS MFG CO. ENGINE-MATERIAL HANDLING DIV., Adv. Pgs. 56-57, 59 ..... **1133 S 70 St, Milwaukee 14** ..... **Wis**
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59 ..... **969 S 70 St, Milwaukee 1** ..... **Wis**
Baker Industrial Trucks Div, Otis Elevator Co ..... 8094 Baker Ave, NW, Cleveland 2 ..... Ohio
Case, J. I., Co, Industrial Div ..... 700 State St, Racine ..... Wis
Getman Brothers Manufacturing Co ..... Box 71, South Haven ..... Mich
Hough, Frank G., Co ..... 726 Seventh St, Libertyville Ill
Hyster Co ..... 2902 NE Clackamas St, Portland 8 ..... Ore
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
Pettibone Mulliken Corp ..... 4710 W Division St, Chicago 51 Ill
Prime Mover Co ..... Muscatine ..... Iowa
Ryerson & Son, Inc ..... Box 8000A, Chicago 80 Ill
Uhrden, Inc ..... 508 Grant St, Dennison ..... Ohio
Yale & Towne Mfg Co, Yale Materials Handling Div ..... 11000 Roosevelt Blvd, Philadelphia 15 ..... Pa

TRUCKS–*DUMP–DOES NOT INCLUDE TRUCKS–SHUTTLE CAR–SHUTTLE BUGGY OR SPECIAL SELF-LOADING*
Autocar Div, White Motor Co ..... Lancaster Pike, Exton ..... Pa
Chrysler Corp, Dodge Truck Div ..... 7900 Joseph Campau Ave, Detroit ..... Mich
DIFFERENTIAL CO., Adv Pg 350 ..... **Findlay** ..... **Ohio**
Differential Steel Car Co ..... Findlay ..... Ohio
Enterprise Wheel & Car Corp ..... Bristol ..... Va
EUCLID DIV, GENERAL MOTORS CORP., Adv Pg 122 ..... **Hudson** ..... **Ohio**
FWD Corp ..... 12 St, Clintonville ..... Wis
FORD MOTOR CO., Adv Pgs. 14-15 ..... **Box 658, Dearborn** ..... **Mich**
Getman Brothers Manufacturing Co ..... Box 71, South Haven ..... Mich
Heil Co—TEC Div ..... 1285 W 70 St, Cleveland 2 ..... Ohio
INTERNATIONAL HARVESTER CO. MOTOR TRUCK DIV., Adv. Pgs. 40-41-42-43 ..... **180 N Michigan Ave, Chicago 1** ..... **Ill**
KW-DART TRUCK CO., Adv Pg 157 ..... **1301 N Manchester Trfwy, Kansas City 20** ..... **Mo**
Koehring Co ..... 3026 W Concordia, Milwaukee 16 ..... Wis
LeTourneau Inc ..... 2390 S MacArthur St, Longview ..... Tex
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65 ..... **2301 N Adams St, Peoria** ..... **Ill**
MACK TRUCKS INC., Adv. Pgs 80-81 ..... **1335 W Front St, Plainfield** ..... **NJ**
Marion Metal Products Co ..... Cheney Ave, Marion ..... Ohio
Oshkosh Motor Truck Inc ..... 2300 Oregon St, Oshkosh ..... Wis
Unit Rig & Equipment Co ..... P O Box 1889, Tulsa 1 ..... Okla
Walter Motor Truck Co ..... School Rd, Voorheesville ..... NY

TRUCKS–*SHUTTLE BUGGY (-½ CU. YD.)*
Getman Brothers Manufacturing Co ..... Box 71, South Haven ..... Mich

TRUCKS–*SHUTTLE CAR (+½ CU. YD.)–Also See ABOVE*
Getman Brothers Manufacturing Co ..... Box 71, South Haven ..... Mich
Goodman Mfg Co ..... Halsted St. & 48th Pl, Chicago 9 Ill
JOY MANUFACTURING CO., Adv. Pgs. 70-71 ..... **333 Henry W Oliver Bldg, Pittsburgh 22** ..... **Pa**
KW-DART TRUCK CO., Adv Pg 157 ..... **1301 N Manchester Trfwy, Kansas City 20** ..... **Mo**
Kersey Mfg Co, Inc ..... Box 151, Blufield ..... Va
NATIONAL MINE SERVICE CO., Adv Pg 144 ..... **2538 Koppers Bldg, Pittsburgh 19** ..... **Pa**

TRUCKS *& TRAILERS–SPECIAL SELF-LOADING–DOES NOT INCLUDE SCRAPERS OR UNITS WITH LOAD MOVING DEVICES ALONE–SUCH AS TRUCKS–SHUTTLE CARS*
DIFFERENTIAL CO., Adv Pg 350 ..... **Findlay** ..... **Ohio**
Differential Steel Car Co ..... Findlay ..... Ohio
Heil Co—TEC Div ..... 1285 W 70 St, Cleveland 2 ..... Ohio
Hyster Co ..... 2902 NE Clackamas St, Portland 8 ..... Ore
MACHINERY CENTER INC., Adv Pg 355 ..... **Box 964, 1201 S 6 St, Salt Lake City 10** ..... **Utah**

TURBINES–See ENGINES

ULTRAVIOLET LIGHTS
Braun Chemical Co ..... 2030 E Broadway, Tucson ..... Ariz
Engelhard Industries, Inc ..... 113 Astor St, Newark ..... NJ
Fisher Research Laboratory, Inc ..... 1975 University Ave, Palo Alto ..... Cal
Geophysical Instrument & Supply ..... 1616 Broadway, Denver 2 ..... Colo
Scott Williams Mineral Co, Inc ..... 440 N Scottsdale Rd, Scottsdale ..... Ariz

UNLOADERS–*R.R.–CAR & TRUCK*
Frank, M. K. ..... 480 Lexington Ave, New York 17 ..... NY
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139 ..... **135 S LaSalle St, Chicago 3** ..... **Ill**
Hough, Frank G., Co ..... 726 Seventh St, Libertyville Ill
Link-Belt Co, Dept. EMJ-61 ..... Prudential Plaza, Chicago 1 Ill
McDOWELL CO, INC, THE WELLMAN ENGINEERING CO., Adv Pg 366 ..... **113 St Clair Ave, NE, Cleveland 14** ..... **Ohio**
OPW-Jordan ..... 6013 Wiehe Rd, Cincinnati 13 ..... Ohio
Pettibone Mulliken Corp ..... 4710 W Division St, Chicago 51 Ill

USED EQUIPMENT–See SEARCHLIGHT SECTION

VALVE OPERATING MECHANISMS–*DOES NOT INCLUDE CONTROLS*

B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Bailey Meter Co	1050 Ivanhoe Rd, Cleveland	Ohio
Cash, A. W., Co	Box 551, Decatur	Ill
Conrader Co, Inc	Box 924, 236 W 17 St, Erie	Pa
Crane Co, Industrial Products Group	4100 S Kedzie Ave, Chicago 32	Ill
DeZurik Corp	Sartell	Minn
Farris Corp	400 Commercial Ave, Palisades Park	NJ
Farris Flexible Valve Corp	463 Commercial Ave, Palisades Park	NJ
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Keystone Valve Corp	5325 Kirby Dr, Houston 5	Tex
Ledeen Mfg Co	3350 N Gilman Rd, El Monte	Cal
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
OPW-Jordan	6013 Wiehe Rd, Cincinnati 13	Ohio
PHILADELPHIA GEAR CORP., Adv Pg 294	**King of Prussia**	**Pa**
Rockwell Mfg Co	400 N Lexington Ave, Pittsburgh 8	Pa
Taylor Instrument Cos	95 Ames St, Rochester 1	NY
Vickers Inc, Electric Products Div	1815 Locust St, St Louis 3	Mo
The Weatherhead Co	300 E 131st St, Cleveland 8	Ohio
Wheeler, C. H., Mfg Co	19th & Lehigh Ave, Philadelphia 32	Pa

VALVES

Alco Products Inc	Dept. 915, Schenectady 5	NY
ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
AMERICAN AIR FILTER CO. INC., Adv Pg 113	**215 Central Ave, Louisville 8**	**Ky**
American Chain & Cable Co, R-P&C Valve Div	Reading	Pa
Automatic Switch Co	Hanover Rd, Florham Park	NJ
B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Bailey Meter Co	1050 Ivanhoe Rd, Cleveland	Ohio
Barksdale Valves	5125 Alcoa Ave, Los Angeles 58	Cal
Barrett Haentjens & Co	Hazleton	Pa
Bitco, Inc	Box 2646, Terminal Annex, Spokane 2	Wash
Cash, A. W., Co	Box 551, Decatur	Ill
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Chiksan Co	330 N Brea Blvd, Brea	Cal
Clarkson Co	735 Lona Verde Ave, Palo Alto	Cal
Commercial Shearing & Stamping Co	Dept. EMJ-4G, 1775 Logan Ave, Youngstown	Ohio
Conrader Co, Inc	Box 924, 236 W 17 St, Erie	Pa
Crosby Valve & Gage Co	43 Kendrick St, Wrentham	Mass
Darling Valve & Mfg Co	Foot of Walnut St, Williamsport	Pa
DuZurik Corp	Sartell	Minn
Dill Mfg Co	700 E 82 St, Cleveland 3	Ohio
Dixon Valve & Coupling Co	Philadelphia 22	Pa
Dominion Engineering Co, Ltd	Box 220, Montreal, Quebec	Can
Dunlron Co, Inc	450 N Findlay St, Dayton 4	Ohio
Edward Valves, Inc, Sub of Rockwell Manufacturing Co	1200 W 145 St, East Chicago	Ind
Fairmont Machinery Co	Fairmont	W Va
Farris Corp	400 Commercial Ave, Palisades Park	NJ
Farris Flexible Valve Corp	463 Commercial Ave, Palisades Park	NJ
Foster, L. B., Co	Box 1647, Pittsburgh 30	Pa
Gallagher Co	Box 209, Salt Lake City 10	Utah
Galland Henning Mfg Co, Nopak Div	2753 S 31 St, Milwaukee 46	Wis
Golden-Anderson Valve Specialty Co	1232 Ridge Ave, Pittsburgh 33	Pa
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
Grinnell Co, Inc	260 W Exchange St, Providence 1	RI
HALLIBURTON CO., Adv Pg 123	**Drawer 1431, Duncan**	**Okla**
Hauck Mfg Co, Equipment Div	124-136 10 St, Brooklyn 15	NY
JENKINS BROS., Adv Pg 109	**100 Park Ave, New York 17**	**NY**
Johnson Corp	882 Wood St, Three Rivers	Mich
Kennedy Valve Mfg Co	Elmira	NY
Keystone Valve Corp	5325 Kirby Dr, Houston 5	Tex
Knox Mfg Co	227 W Clinton Ave, Oakyn	NJ
Ladish Co	5481 S Packard Ave, Cudahy	Wis
Ledeen Mfg Co	3350 N Gilman Rd, El Monte	Cal
LINATEX CORP OF AMERICA, Adv Pg 159	**P O Drawer D, Stafford Springs**	**Conn**
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Lunkenheimer Co	Beekman St. & Waverly Ave. Cinc 14	Ohio
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
Metal Goods Corp	6800 Page Blvd. St Louis 14	Mo
Mueller Co	512 W Cerro Gordo St, Decatur	Ill
Ohio Brass Co	Mansfield	Ohio
OPW-Jordan	6013 Wiehe Rd, Cincinnati 13	Ohio
Ohio Injector Co	275 Main St, Wadsworth	Ohio
Oilgear Co	1560 W Pierce St, Milwaukee 4	Wis
Parker-Hannifin Corp	17325 Euclid Ave, Cleveland 12	Ohio
Red Jacket Co, Inc	500 Bell Ave, Carnegie	Pa
Rockwell Mfg Co	400 N Lexington Ave, Pittsburgh 8	Pa
Rockwell, W. S., Co	200 Eliot St, Fairfield	Conn
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Stockham Valves & Fittings	Box 2592, Birmingham	Ala
Taylor Instrument Cos	95 Ames St, Rochester 1	NY
U S Rubber Co, Mechanical Goods Div	1230 Ave of the Americas, New York 20	NY
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl. Pittsburgh 30**	**Pa**
Vapor Recovery Systems Co	7820 N Alameda St, Compton	Cal
Vickers Inc	Administrative & Eng Center, Detroit 32	Mich
VICTAULIC CO OF AMERICA, Adv Pg 234	**P O Box 509E, Elizabeth**	**NJ**
Vogt, Henry, Machine Co	1000 W Ormsby, Louisville 10	Ky
Walworth Co	750 Third Ave, New York 17	NY
The Weatherhead Co	300 E 131st St, Cleveland 8	Ohio
Westinghouse Air Brake Co, Ind Products Div	P O Box 36, Wilmerding	Pa
Yarnall-Waring Co	102 E Mermaid Ln, Philadelphia 18	Pa

VENTILATION TUBING–*NON-METALLIC–DOES NOT INCLUDE PIPE-VENTILATION*

Aeroquip Corp	300 S East Ave, Jackson	Mich
AMERICAN BRATTICE CLOTH CORP., Adv Pg 366	**Warsaw**	**Ind**
Bemis Bros. Bag Co	408 Pine St, St Louis 2	Mo
Daniels, C. P., Inc	Daniels	Wd
DUPONT DE NEMOURS & CO., E. I., TEXTILE FIBERS DEPT., Adv Pg 30	**2446 Nemours Bldg, Wilmington**	**Del**
FLEXAUST CO., Adv Pg 346	**100 Park Ave. New York 17**	**NY**
Flexible Tubing Co	Guilford	Conn
The Rockaron Co, Ltd	P O Box 1089, Sudbury	Ont

VIBRATORS & VIBRATING MECHANISM–*Also See* CAR SHAKERS; SCREEN ECCENTRICS

Ajax Flexible Coupling Co, Inc	Westfield	NY
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St, New York 17**	**NY**
Cleveland Vibrator Co	2828 Clinton Ave, Cleveland 13	Ohio
DIESEL ENERGY CORP. U S SUB OF KLOCKNER-HUMBOLDT-DEUTZ AG, Adv Pg 339	**82 Beaver St, New York**	**NY**
Dravo Corp	Neville Island, Pittsburgh 25	Pa
ERIEZ MFG CO., Adv Pg 365	**315 Magnet Dr, Erie**	**Pa**
Fairmont Machinery Co	Fairmont	W Va
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Homelite, Div of Textron Inc	75 Riverdale Ave, Port Chester	NY
Koehring Co	3026 W Concordia, Milwaukee 16	Wis
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Martin Engineering Co	Neponset	Ill
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Remington Arms Co, Inc	939 Barnum Ave, Bridgeport 2	Conn
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
Viber Co	726 S Flower, Burbank	Cal

WAGON DRILLS–See DRILLS

WASHERS–*MINERAL LOG-PUG-ETC.*–See SCRUBBERS

WASHING PLANTS–*SAND & GRAVEL-COMPLETE-MOBILE & PORTABLE*

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV., Adv Pg 124	**5 Main St, Lima**	**Ohio**
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
Davis Foundry & Machine Works	Old Furnace Rd, Rome	Ga
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
Diamond Iron Works Div, Goodman Mfg Co	Halsted St. & 48 Pl, Chicago 9	Ill
Eagle Iron Works	262 Holcomb Ave, Des Moines 4	Iowa
Hack Engineering Co	124 Wazee Market, Denver	Colo
HAMMERMILLS, INC., Adv Pg 376	**625 C Ave. NW, Cedar Rapids**	**Iowa**
Industrial Engineering & Construction Co	1st Natl Bank Bldg, Fairmont	W Va
Iowa Mfg Co	916 16 St. NE, Cedar Rapids	Iowa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
McLANAHAN CORP., Adv Pg 328	**Hollidaysburg**	**Pa**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
Smith Engineering Works, Div of Barber-Greene	532 E Capitol Dr, Milwaukee 12	Wis
Universal Dredge Mfg Co	124 Wazee Market, Denver 4	Colo

WATER CLARIFICATION & TREATMENT EQUIPMENT–*Also See* ION EXCHANGE

ALLIS-CHALMERS MFG CO. INDUSTRIES GROUP, Adv. Pgs. 56-57, 59	**969 S 70 St, Milwaukee 1**	**Wis**
B-I-F Industries, Inc	345 Harris Ave, Providence 1	RI
Baker & Adamson Products, General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Bird Machine Co	South Walpole	Mass
CHAIN BELT CO., Adv Pg 331	**4679 W Greenfield Ave, Milwaukee 1**	**Wis**
Cochrane Div, Crane Co	17th St. below Allegheny Ave. Phila 32	Pa
DENVER EQUIPMENT CO., Adv Pg 76	**Box 5268, Denver 17**	**Colo**
DORR OLIVER INC., Adv. Pgs. 8-9	**Havemeyer Ln, Stamford**	**Conn**
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
HARDINGE CO. INC., Adv. Pgs. 348-341	**240 Arch St, York**	**Pa**
Infilco, Inc	901 S Campbell Ave, Tucson	Ariz
Ionics Inc	152 Sixth St, Cambridge 42	Mass
Jeffrey Mfg Co	886 N 4th St, Columbus 16	Ohio
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
MAXIM EVAPORATOR DIV. AMERICAN MACHINE & FOUNDRY CO., Adv Pg 345	**6 Hill Lane, Waterford**	**Conn**
McNALLY PITTSBURG MFG CORP., Adv Pg 137	**307 W Third St. Pittsburg**	**Kan**
Permutit Co, Div, Pfaudler Permutit Inc	50 W 44 St, New York 36	NY
Wallace & Tiernan Inc	Belleville 9	NJ

WATER CLARIFICATION & TREATMENT CHEMICALS–*DOES NOT INCLUDE ION EXCHANGE RESINS*–*Also See* FLOCCULATING REAGENTS

AMERICAN CYANAMID CO. EXPLOSIVES & MIXING CHEMICALS DEPT., Adv Pg 45	**Bound Brook**	**NJ**
AMERICAN POTASH & CHEMICAL CO., Adv Pg 62	**3000 W 6 St, Los Angeles 54**	**Cal**
Armour Industrial Chemical Co	110 N Wacker Dr, Chicago 6	Ill
ATLAS POWDER CO., Adv. Pgs. 178-179	**Wilmington 99**	**Del**
Baker & Adamson Products, General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Burtonite Co	330 Passaic Ave, Nutley 10	NJ
Canadian Industries, Ltd	Box 10, Montreal	Can
DOW CHEMICAL CO., Adv. Pgs. 152-153	**Midland**	**Mich**
Food Machinery & Chemical Corp, Mineral Products Div, Chlor-Alkali Div	161 E 42 St, New York 17	NY
General Chemical Div, Allied Chemical Corp	40 Rector St, New York 6	NY
Graver Water Conditioning Co, Union Tank Car Co, Div	216 W 14 St, New York 11	NY
Ionac Chemical Co, Div, Pfaudler Permutit Inc	Birmingham	NJ
Lancaster Pump & Mfg Co, Inc	Lancaster	Pa
Marathon Div, American Can Co, Chemical Sales Dept	Menasha	Wis
Nalco Chemical Co	6216 W 66th Pl, Chicago 39	Ill
Onyx Chemical Corp	190 Warren St, Jersey City	NJ
Pacific Lumber Co	100 Bush St, San Francisco 4	Cal
Pennsalt Chemicals Corp	3 Penn Center, Philadelphia 2	Pa
Permutit Co, Div, Pfaudler Permutit Co	50 W 44 St, New York 36	NY
PHELPS DODGE REFINING CORP., Adv Pg 368	**300 Park Ave, New York 22**	**NY**
PHILADELPHIA QUARTZ CO., Adv Pg 376	**1135 Public Ledger Bldg, Phila 6**	**Pa**
Stein, Hall & Co, Inc	285 Madison Ave, New York 17	NY

WEIGH HOPPERS–See SCALES

WELDING & CUTTING EQUIPMENT–*Also See* METALLIZING EQUIPMENT

ALLOY RODS CO., Adv Pg 329	**Box 1828, York**	**Pa**
Arcair Co	Box 431, Lancaster	Ohio
Arcos Corp	1500 S 50 St, Philadelphia 43	Pa
Engelhard Industries, Inc	113 Astor St, Newark	NJ
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave, Milwaukee 46**	**Wis**
Hobart Bros Co	Main & Adams Sts, Troy 1	Ohio
Industrial Air ProductsCo	3200 N W Yeon Ave, Portland 10	Ore
Lincoln Electric Co	22801 St Clair Ave, Cleveland 17	Ohio
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Marquette Manufacturing Co, Div of Marquette Corp	307 E Hennepin Ave, Minneapolis 14	Minn
The McKay Co	1005 Liberty Ave, Pittsburgh 22	Pa
Miller Electric Mfg Co	Box 798, Appleton	Wis
Rexarc Inc, Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Smith Welding Equipment Corp	2633 SE 4 St, Minneapolis 14	Minn
STOODY CO., Adv Pg 314	**Box 901, Whittier**	**Cal**
Vickers Inc, Electric Products Div	1815 Locust St, St Louis 3	Mo
Victor Equipment Co, Alloy Rod & Metal Div	13808 E Imperial Hwy, Norwalk	Cal
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

WELDING RODS–*ELECTRODES–SOLDER–ETC.*–See METALLIZING EQUIPMENT

ALLOY RODS CO., Adv Pg 329	**Box 1828, York**	**Pa**
Aluminum Co of America	1501 Alcoa Bldg, Pittsburgh 19	Pa
American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St, Chicago Heights**	**Ill**
American Chain & Cable Co, Page Steel & Wire Div	Monessen	Pa
Ampco Metal, Inc	1739 S 38 St, Milwaukee 1	Wis
Arcair Co	Box 431, Lancaster	Ohio
Arcos Corp	1500 S 50 St, Philadelphia 43	Pa
Belmont Smelting & Refining Works	330 Belmont Ave, Brooklyn 7	NY
Eutectic Welding Alloys Corp	40-40 172 St, Flushing 58	NY
HARNISCHFEGER CORP., Adv Pg 1	**4444 W National Ave, Milwaukee 46**	**Wis**
Haynes Stellite Co, Div, Union Carbide Corp	Kokomo	Ind
Hobart Bros Co	Main & Adams Sts, Troy 1	Ohio
Huntington Alloy Products Div, The International Nickel Co, Inc	Huntington 17	W Va
Industrial Air Products Co	3200 N W Yeon Ave, Portland 10	Ore
Lincoln Electric Co	22801 St Clair Ave, Cleveland 17	Ohio
Linde Co, Union Carbide Corp	270 Park Ave, New York 17	NY
Marquette Manufacturing Co, Div of Marquette Corp	307 E Hennepin Ave, Minneapolis 14	Minn
The McKay Co	1005 Liberty Ave, Pittsburgh 22	Pa
Metal Goods Corp	6800 Page Blvd, St Louis 14	Mo
Ohio Carbon Co	12508 Berea Rd, Cleveland 11	Ohio
Rexarc Inc, Sight Feed Generator Div	P O Box 47, West Alexandria 2	Ohio
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Stackpole Carbon Co	St Marys	Pa
STOODY CO., Adv Pg 314	**Box 901, Whittier**	**Cal**
Taylor Wharton Div, Harsco Corp	High Bridge	NJ
Victor Equipment Co, Alloy Rod & Metal Div	13808 E Imperial Hwy, Norwalk	Cal
WESTINGHOUSE ELECTRIC CORP., Adv. Pgs. 60-61, 150-151	**Box 2278, Pittsburgh 30**	**Pa**

WELDMENTS–*Also See* BUCKET TEETH; CASTINGS; FORGINGS; TRACTOR WEAR-REPLACEMENT PARTS

Alco Products Inc	Dept. 915, Schenectady 5	NY
American Brake Shoe Co	530 Fifth Ave, New York 36	NY
AMERICAN BRAKE SHOE CO. AMERICAN MANGANESE STEEL DIV., Adv. Pgs. 148-149	**389 E 14 St, Chicago Heights**	**Ill**
Baldwin-Lima-Hamilton Corp, Indl Eqpt Div	Philadelphia 42	Pa
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
Enterprise Wheel & Car Corp	Bristol	Va
FALK CORP., Adv Pg 34	**Box 492, Milwaukee 1**	**Wis**
GENERAL AMERICAN TRANSPORTATION CORP., Adv Pg 139	**135 S LaSalle St, Chicago 3**	**Ill**
Guyan Machinery Co	755 Stratton St, Logan	W Va
Ladish Co	5481 S Packard Ave, Cudahy	Wis
Lakeside Bridge & Steel Co	5306 N 33 St, Milwaukee 9	Wis
MORDBERG MFG CO., Adv. Pgs. 306-307, 308, 309	**3073 S Chase Ave, Milwaukee 1**	**Wis**
Simmons Boiler & Machine Co	9011 Central Ave, Detroit 4	Mich
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
TREADWELL, N.H., CO. INC., Adv Pg 75	**140 Cedar St, New York 6**	**NY**
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

WINCHES–*AIR*

ATLAS COPCO, INC., Adv. Pgs. 54-55	**545 Fifth Ave, New York 17**	**NY**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St, New York 17**	**NY**
Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
Crane Co, Industrial Products Group	4100 S Kedzie Ave, Chicago 32	Ill
ElmCO CORP., Adv Pg 335	**501 W 6th South St. Salt Lake City 10**	**Utah**
Hose Accessories Co	17 St. & Lehigh Ave, Philadelphia 32	Pa
INGERSOLL-RAND CO., Adv. Pgs. 7 & 277	**11 Broadway, New York 4**	**NY**
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
Lidgerwood Mfg Co	7 Dey St, New York	NY
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
Meckum Engineering Inc	Dayton Rd, Ottawa	Ill
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Thor Power Tool Co	175 N State St, Aurora	Ill

WINCHES–*DIESEL & GASOLINE*

American Hoist & Derrick Co	63 S Robert St, St Paul 7	Minn
Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
Gar Wood Industries, Inc	Wayne	Mich
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
Lidgerwood Mfg Co	7 Dey St, New York	NY

Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

WINCHES—ELECTRIC

CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St, New York 17**	**NY**
Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
The Forker Corp	2044 Random Rd, Cleveland 6	Ohio
Gar Wood Industries, Inc	Wayne	Mich
Iowa Mfg Co	916 16 St, NE, Cedar Rapids	Iowa
JOY MANUFACTURING CO., Adv, Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
Lakeside Bridge & Steel Co	5306 N 33 St, Milwaukee 9	Wis
LeTourneau Inc	2390 S MacArthur St, Longview	Tex
Lidgerwood Mfg Co	7 Dey St, New York	NY
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
Robbins & Myers Inc	1345 Lagonda Ave, Springfield	Ohio
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
Shepard Niles Crane & Hoist Corp	Schuyler Ave, Montour Falls	NY
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

WINCHES—HAND-DOES NOT INCLUDE HOISTS-LIFT-HAND CHAIN

Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
The Forker Corp	2044 Random Rd, Cleveland 6	Ohio
Gar Wood Industries, Inc	Wayne	Mich
Harrington Co	Gravers Rd, Plymouth Meeting	Pa
LUG-ALL CO., Adv Pg 357	**Haverford**	**Pa**
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla
Western Gear Corp, Industrial Pitts Div	Box 126, Belmont	Cal
Yale & Towne Mfg Co, Yale Materials Handling Div	11000 Roosevelt Blvd, Philadelphia 15	Pa

WINCHES—HYDRAULIC

Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
Hillman, C. Kirk, Co, Inc	3201 First Ave, S, Seattle 4	Wash
Lakeside Bridge & Steel Co	5306 N 33 St, Milwaukee 9	Wis
Lidgerwood Mfg Co	7 Dey St, New York	NY
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla

WINCHES—PORTABLE & MOVABLE

ACKER DRILL CO. INC., Adv Pg 360	**Box 838, Scranton**	**Pa**
CHICAGO PNEUMATIC TOOL CO., Adv Pg 16	**6 E 44th St, New York 17**	**NY**
Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
The Forker Corp	2044 Random Rd, Cleveland 6	Ohio
JOY MANUFACTURING CO., Adv. Pgs. 70-71	**333 Henry W Oliver Bldg, Pittsburgh 22**	**Pa**
Lidgerwood Mfg Co	7 Dey St, New York	NY
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Thor Power Tool Co	175 N State St, Aurora	Ill
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla

WINCHES—STATIONARY

American Hoist & Derrick Co	63 S Robert St, St Paul 7	Minn
Christian, J. D., Engineers	480 Potrero Ave, San Francisco 10	Cal
The Forker Corp	2044 Random Rd, Cleveland 6	Ohio
Lidgerwood Mfg Co	7 Dey St, New York	NY
Link-Belt Co, Dept. EMJ-61	Prudential Plaza, Chicago 1	Ill
Manning, Maxwell & Moore Inc, Shaw Box Crane & Hoist Div	Muskegon	Mich
David Round & Son, Inc	Box 9557, Cleveland 39	Ohio
SAUERMAN BROS. INC., Adv Pg 326	**626 S 28 Ave, Bellwood**	**Ill**
STEPHENS-ADAMSON MFG CO., Adv Pg 164	**260 Ridgeway Ave, Aurora**	**Ill**
Superior-Lidgerwood-Mundy Corp	1101 John Ave, Superior	Wis
Tulsa Products Div, Vickers Inc	731 E First St, Tulsa 20	Okla
Vulcan Iron Works Co	2960 S Fox, Englewood	Colo

WIRE CLOTH

American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
Buffalo Wire Works Co	449 Terrace, Buffalo 2	NY
Cambridge Wire Cloth Co	152 Linkwood Rd, Cambridge	Md
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Hewitt-Robins, Inc	666 Glenbrook Rd, Stamford	Conn
Hoyt Wire Cloth Co	Box 1577, Lancaster	Pa
Manganese Steel Forge Co	Richmond & Castor Ave, Philadelphia	Pa
Metal Goods Corp	8800 Page Blvd, St Louis 14	Mo
Multi-Metal Wire Cloth Co, Inc	1349 Garrison Ave, New York 59	NY
National Standard Co	Eight & Howard, Niles	Mich
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
Newark Wire Cloth Co	370 Verona Ave, Newark 4	NJ
Pioneer Engineering, Div of Poor & Co, Inc	3200 Como Ave, SE, Minneapolis 14	Minn
SIMPLICITY ENGINEERING CO., Adv Pg 349	**Durand**	**Mich**
Southwestern Engineering Co	4800 Santa Fe Ave, Los Angeles 58	Cal
Tyler, W. S., Co	3615 Superior Ave, Cleveland 14	Ohio
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**

WIRE FENCING—See FENCING

WIRE ROPE

American Chain & Cable Co, American Cable Div	Wilkes-Barre	Pa
American Chain & Cable Co, Hazard Wire Rope Div	Wilkes-Barre	Pa
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
BRODERICK & BASCOM ROPE CO., Adv Pg 10	**4203 Union Blvd, St Louis 15**	**Mo**
Chase Brass & Copper Co	236 Grand St, Waterbury 20	Conn
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Failing, George E., Co	Enid	Okla
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Leschen Wire Rope Div, H. K. Porter Co, Inc	2727 Hamilton Ave, St Louis 12	Mo
LETOURNEAU - WESTINGHOUSE CO., Adv. Pgs. 63, 64-65	**2301 N Adams St, Peoria**	**Ill**
Macwhyte Wire Rope Co	2937 14th Ave, Kenosha	Wis
Megator Corp	930 Manchester Ave, Pittsburgh 12	Pa
Metals Goods Corp	8800 Page Blvd, St Louis 14	Mo
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
RIBLET TRAMWAY CO., Adv Pg 323	**P O Box 5228, Spokane 17**	**Wash**
ROEBLING'S, JOHN A., SONS, DIV. COLORADO FUEL & IRON CORP., Adv Pg 38	**640 S Broad St, Trenton 2**	**NJ**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Sauerman Bros. Inc	626 S 28 Ave, Bellwood	Ill
Union Wire Rope, Armco Steel Corp	2100 Manchester Ave, Kansas City 26	Mo
U S STEEL CORP., Adv. Pgs. 12, 280	**525 Wm Penn Pl, Pittsburgh 30**	**Pa**
Wire Rope Corp of America Inc	609 N 2 St, St Joseph	Mo

WIRE ROPE DRESSING—See LUBRICANTS

WIRE ROPE FITTINGS

American Chain & Cable Co, American Cable Div	Wilkes-Barre	Pa
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BRODERICK & BASCOM ROPE CO., Adv Pg 10	**4203 Union Blvd, St Louis 15**	**Mo**
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Electric Steel Foundry Co	214 NW 25 Ave, Portland 10	Ore
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Leschen Wire Rope Div, H. K. Porter Co, Inc	2727 Hamilton Ave, St Louis 12	Mo
Macwhyte Wire Rope Co	2937 14th Ave, Kenosha	Wis
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
ROEBLING'S, JOHN A., SONS, DIV. COLORADO FUEL & IRON CORP., Adv Pg 38	**640 S Broad St, Trenton 2**	**NJ**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
SAUERMAN BROS. INC., Adv Pg 326	**626 S 28 Ave, Bellwood**	**Ill**
Sorel Steel Foundries Ltd	1405 Peel St, Montreal 2, P.Q.	Can
Union Wire Rope, Armco Steel Corp	2100 Manchester Ave, Kansas City 26	Mo

WIRE ROPE SLINGS

American Chain & Cable Co, American Cable Div	Wilkes-Barre	Pa
American Steel & Wire Div, U.S. Steel Corp	614 Superior NW, Cleveland 13	Ohio
BETHLEHEM STEEL CO., Adv Pg 46	**Bethlehem**	**Pa**
BRODERICK & BASCOM ROPE CO., Adv Pg 10	**4203 Union Blvd, St Louis 15**	**Mo**
Colorado Fuel & Iron Corp	575 Madison Ave, New York 22	NY
COLORADO FUEL & IRON CORP., Adv. Pgs. 32-33	**Continental Oil Bldg, Denver 2**	**Colo**
Columbia-Geneva Steel Div, U.S. Steel Corp	120 Montgomery St, San Francisco 6	Cal
Jones & Laughlin Steel Corp	3 Gateway Center, Pittsburgh 30	Pa
Leschen Wire Rope Div, H. K. Porter Co, Inc	2727 Hamilton Ave, St Louis 12	Mo
Macwhyte Wire Rope Co	2937 14th Ave, Kenosha	Wis
Midwestern Engine & Equipment Co	Box 1886, Tulsa	Okla
NATIONAL MINE SERVICE CO., Adv Pg 144	**2530 Koppers Bldg, Pittsburgh 19**	**Pa**
National Tube Div, U.S. Steel Corp	525 William Penn Pl, Pittsburgh	Pa
H. K. Porter Co, Inc	Porter Bldg, 601 Grant St, Pittsburgh 19	Pa
H. K. PORTER CO. INC. LESCHEN WIRE ROPE DIV., Adv Pg 160	**601 Grant St, Pittsburgh 19**	**Pa**
ROEBLING'S, JOHN A., SONS, DIV. COLORADO FUEL & IRON CORP., Adv Pg 38	**640 S Broad St, Trenton 2**	**NJ**
Ryerson & Son, Inc	Box 8000A, Chicago 80	Ill
Union Wire Rope, Armco Steel Corp	2100 Manchester Ave, Kansas City 26	Mo
Wire Rope Corp of America Inc	609 N 2 St, St Joseph	Mo

WIRE SCREEN—See SCREEN

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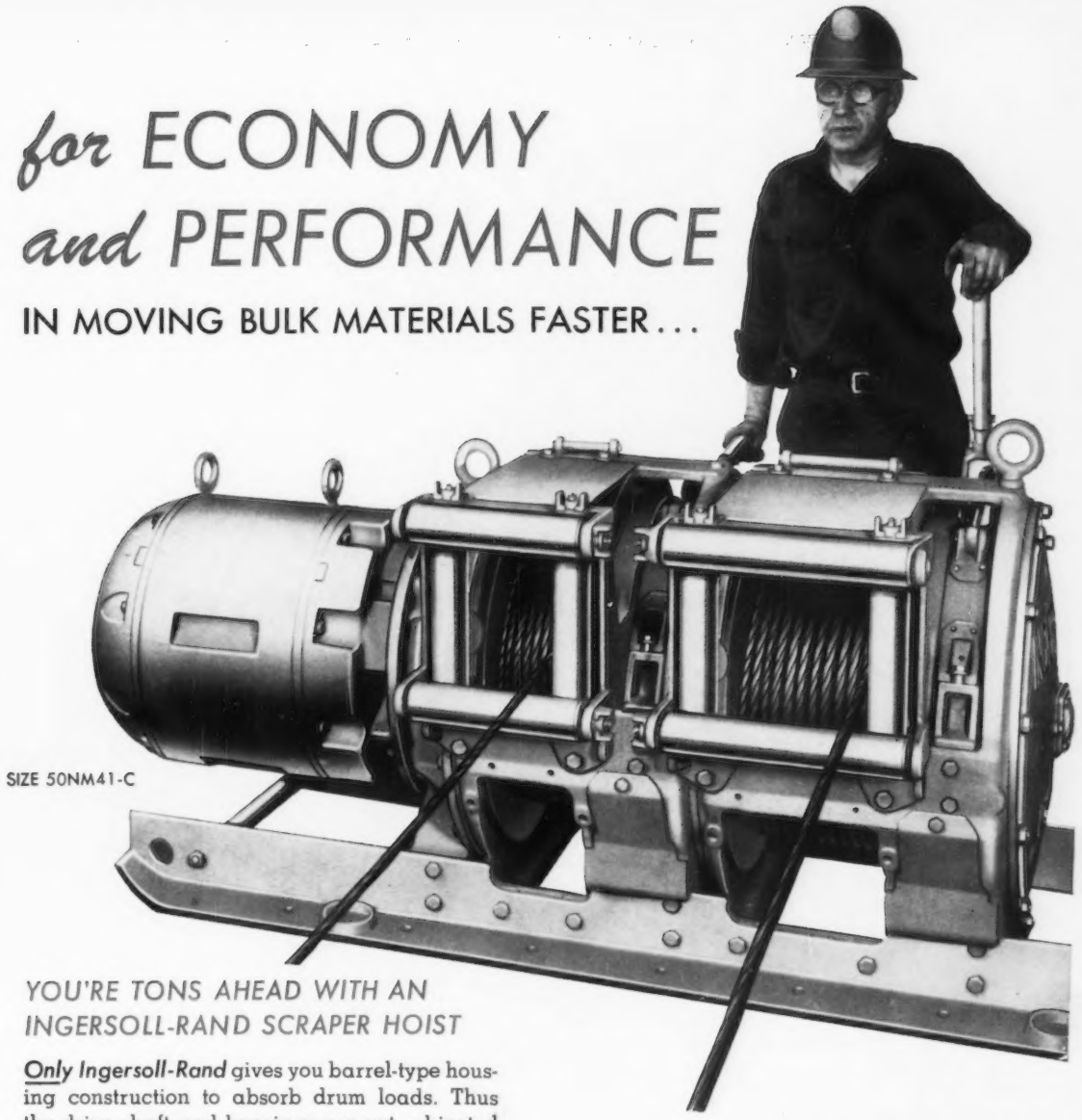

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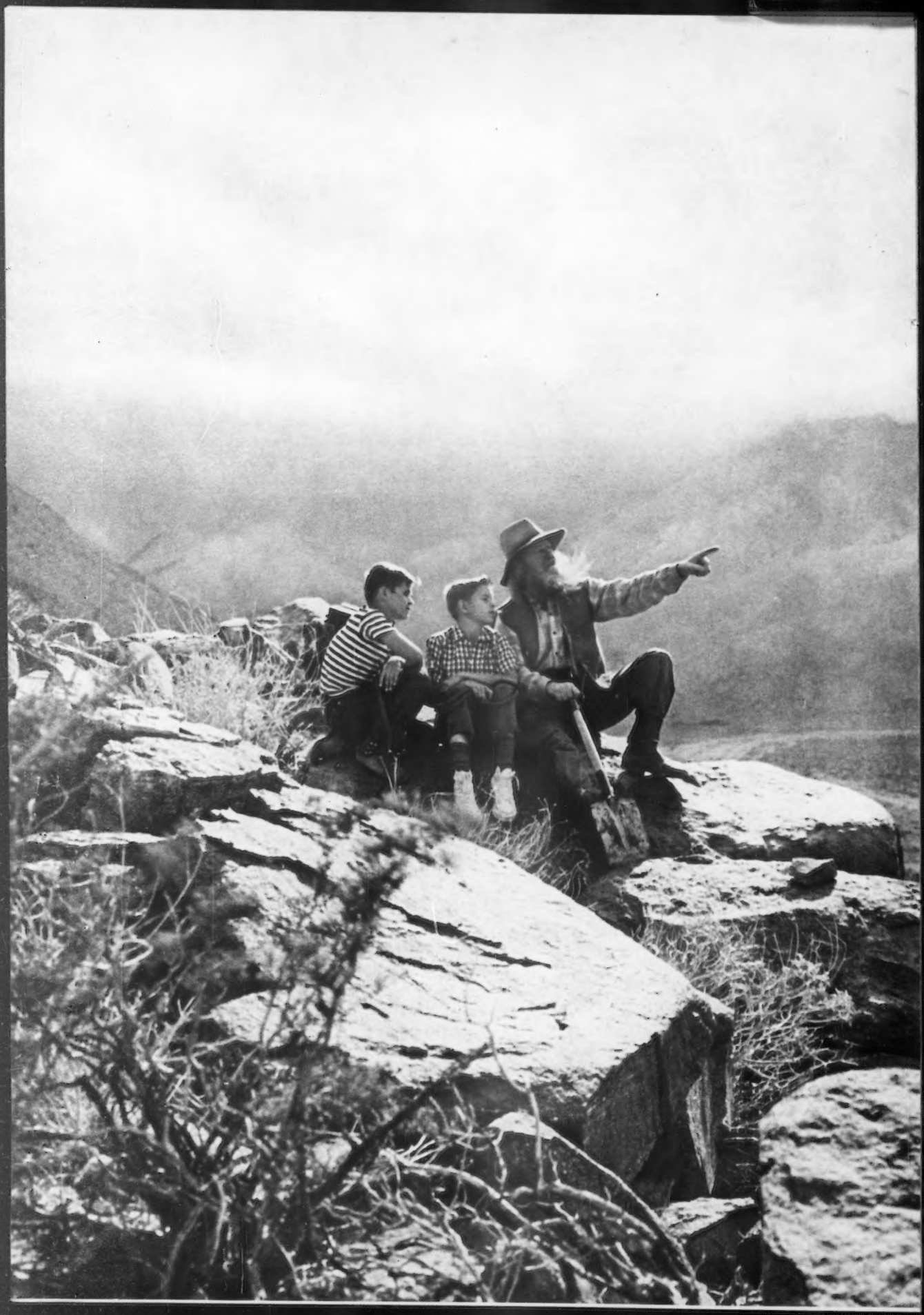

An old-timer in California—Photo by Mark Shaw

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Canada, Ottawa, Ontario: Canadian Aero Service Ltd., 348 Queen St.
Canada, Toronto, Ontario: Canadian Aero Service Ltd., 347 Bay St.
Australia, New South Wales, Hurstville, P. O. Box 6
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Colombia, Bogota: De Greiff, Umana and CIA Avenida Jimenex De Quesada No. 8-49 Oficinas 803-8-4
Iran, Tehran: 33 Khochbakhti Ave., P. O. Box 1725
Lebanon, Beirut: P. O. Box 3
Saudi Arabia, Jedda: P. O. Box 97
Southern Rhodesia, Salisbury: 45 Speke Ave.
Spain, Madrid: Avenida Generalisimo 53-10-C
Venezuela, Caracas: Tiav, Avenida, Casanova-Quinta Tiav

Ainsworth & Sons, Wm. Inc., 2151 Lawrence St., Denver 5, Colo.

Air Placement Equipment Co., 1000 West 25th St., Kansas City 8, Missouri

Allen-Sherman-Hoff Pump Co., P. O. Box 635, Paoli, Pa.
Illinois, Chicago 5: 407 S. Dearborn St.
New York, New York 16: 271 Madison Ave.

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Alabama, Birmingham 9, 1824-29th Ave., South
Arizona, Phoenix, 3300 North Central Ave.
California, Los Angeles 13, 417 S. Hill St.
California, San Diego 1, 747 Ninth Av
California, San Francisco 7, 650 Harrison St.
Colorado, Denver 3, 655 Broadway Bldg., Suite 205
Florida, Jacksonville 7, 1628 San Marco Blvd.
Florida, Miami 32, 25 S.E. 2nd Ave.
Tampa 1, 1723 Grand Central Bldg.
Georgia, Atlanta 3, 57 Forsythe St., N.W.
Illinois, Chicago 3, 135 S. La Salle St.
Illinois, Peoria 2, Commercial Natl. Bank Bldg.
Illinois, Rockford, 303 North Main St.
Indiana, Evansville 9, 329 Main St.
Indiana, Indianapolis 18, 3590 N. Meridian St.
Kansas, Wichita 2, 114 South Main St.
Kentucky, Louisville 8, 233 East Burnett Ave.
Louisiana, New Orleans 12, 2001 Canal St.
Louisiana, Shreveport 23, 624 Travis St.
Maryland, Baltimore 18, 1115 East 30th St.
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Michigan, Grand Rapids 2, 5-7 Lyon St., N. W.
Michigan, Jackson, 297 W. Michigan Ave.
Minnesota, Duluth 2, 10 E. Superior St.
Minnesota, Minneapolis 16, 3033 Excelsior Blvd.
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New York, New York 7, 100 Church St.
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Ohio, Toledo 4, 245 Summit St.
Ohio, Youngstown 3, 25 E. Boardman St.
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Oklahoma, Tulsa 3, 320 E. Archer St.
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Pennsylvania, Philadelphia 3, 1617 Pa. Blvd.
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Texas, Beaumont, 330 Liberty St.
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Washington, Spokane 17, West 12 Indiana Ave.
West Virginia, Charleston 1, 179 Summers St.
Wisconsin, Appleton, 1000 West College Ave.
Wisconsin, Milwaukee 3, 2040 West Wisconsin Ave.
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Canada, Winnipeg, Manitoba, 862 Dufferin Ave.

Alloy Rods Co., P. O. Box 1828, York, Pa.
California, El Segundo: 750 Lairport St.
California, Emeryville 8: 4001 Hollis St.
Illinois, Chicago 11: 445 North Lake Shore Dr.
Massachusetts, Waltham 54: 11 Sun St.
New Jersey, Newark 2: 30 Warren Place
Ohio, Cleveland 9: 215 Brookpark Rd.
Pennsylvania, Pittsburgh 18: 2437 Waverly St., Swissvale

American Air Filter Co., Inc., 215 Central Ave., Louisville 8, Ky.
Arizona, Phoenix: 4808 North 7th Ave.
California, Los Angeles 42: 6181 York Blvd.
California, San Francisco 3: 460 9th St.
Colorado, Denver 2: 2415—15th St.
Minnesota, Duluth 2: Alsworth Bldg.
Utah, Salt Lake City 1, 44 W. 8th South St.
Canada, Ontario, Toronto 18: 3355A Bloor Street West
Canada, Quebec, Montreal 9: 400 Stinson Blvd.

American Biltrite Rubber Co., Inc. Boston Woven Hose & Rubber Div. P. O. Box 1071, Boston 3, Mass.
Arizona, Phoenix: 327 E. Jefferson St.
California, Los Angeles: 4464 District Blvd.
California, Oakland: 103 Grand Avenue
Colorado, Denver 4: 710 West Colfax Ave.
Georgia, Atlanta: 2131 Plaster Bridge Rd.
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Texas, Dallas 7: 2621 Irving Blvd.
Virginia, Richmond: 2103 No. Hamilton Street

American Brattice Cloth Corp., Argonne Road, Warsaw, Ind.
Ohio, Cleveland: 1313 West 11th St.
Pennsylvania, Pittsburgh: One Cedar Boulevard

American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N. Y.
Colorado, Denver: 1445 Kearney St.
Massachusetts, Maynard: Box 5
Missouri, Kansas City: 3125 Gilham Plaza
Missouri, St. Louis: 5025 Pattison Ave.
New Mexico, Albuquerque: 1719 Van Court, S. W.
Oklahoma, Tulsa: Route 3, Box 192
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American Machine & Foundry Co., Maxim Evaporator Div., 6 Mill Lane, Waterford, Connecticut
Colorado, Denver 2: 2001 First National Bank Bldg.

American Machine & Metals, Inc., East Moline, Ill.
California, Pasadena: 385 East Green St.
Colorado, Denver: 847 East 17th Ave.
Georgia, Atlanta 9: 1371 Peachtree St., N.E.
Illinois, Chicago: 600 South Michigan Ave.
Michigan, Livonia: 12201 Merriman Rd.
Minnesota, Minneapolis: 620 Plymouth Bldg.
New York, New York 7: 233 Broadway
Ohio, Cincinnati: 140 West 6th St.
Ohio, Cleveland: 3639 Lee Rd.
Ohio, Cuyahoga Falls: 1928 Portage Trail
Pennsylvania, Pittsburgh: 2210 Koppers Bldg.
Texas, Houston: 2401 Dunstan Rd.
West Virginia, Charleston 3: 1108 Nelson Bldg.

American Manganese Steel Div., American Brake Shoe Co., 389 East 14th St., Chicago Heights, Ill.
Arizona, Phoenix: 8026 N. 16th Ave.
California, Los Angeles: 5805 Downey Rd.
California, Oakland: 850 Ferry St.
Colorado, Denver: 4th and Wazee Streets
Delaware, New Castle
Illinois, Chicago: 155 North Wacker Drive
Minnesota, Duluth: 2829 Branch St.
Missouri, St. Louis: 6600 Ridge Ave.
New York, New York: 530 Fifth Ave.
Pennsylvania, Pittsburgh : 717 Grant Building
Canada, Jollette
Canada, Montreal: 1405 Peel Street

American Mine Door Co., 2039 Dueber Ave., S.W., Canton 6, Ohio.
Alabama, Birmingham 5: 429 South 24th St.
Arizona, Phoenix: 35 E. Pierson St.
Colorado, Denver 7, 3847 Forest St.
Indiana, Vincennes: 1648 North 13th St.
Michigan, Ishpeming: 115 South First St.
Minnesota, Hibbing: 522 West 27th St.
New Mexico, Albuquerque: 1404 Martha NE
Utah, Salt Lake City 4: 1020 South Sixth West
Washington, Spokane: 311 N. Adams Road

American Potash & Chemical Corp., 3000 West 6th St., Los Angeles 54, Calif.
California, San Francisco 4: 235 Montgomery St.
Illinois, Chicago 45: 3557 West Peterson
New York, New York 16: 99 Park Ave.

American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.

American Viscose Corp., 350 Fifth Ave., New York 1, N.Y.
North Carolina, Charlotte 2: 221 South Church St.
Pennsylvania, Philadelphia 3: 1617 Pennsylvania Blvd.
Rhode Island, Providence 3: 630 Hospital Trust Bldg.

Athey Products Corp., 5631 West 65th St., Chicago 38, Illinois

Atlas Copco Inc., 545 Fifth Ave., New York 17, N.Y.
Arizona, Phoenix: 1326 N. 22nd Ave.
California, San Carlos: 930 Brittan Ave.
Colorado, Denver: 2360 S. Delaware St.
Georgia, Atlanta: 1450 Northside Drive N.W.
Minnesota, Duluth: 214 S. 1st Ave.. E.
Missouri, St. Louis: 1525 Page Industrial Blvd.
New Jersey, Paramus: 610 Industrial Ave.
Utah, Salt Lake City: 1065 S. 2nd W. St.
Washington, Spokane: 1509 W. 2nd St.

Atlas Powder Co., Wilmington 99, Del.
California, San Mateo: 2036 Pioneer Court
Delaware, Wilmington 99
Illinois, Chicago 3: 1606 Field Bldg., 135 S. LaSalle St.
Missouri, Joplin: 612 First National Bldg.
Pennsylvania, Pittsburgh 22: Rm. 727, #4 Gateway Center
Tennessee, Knoxville 3: Hamilton National Bank Bldg.
Washington, Seattle 1: 1320 Joseph Vance Bldg.

B

Baldwin-Lima-Hamilton Corp., Lima Construction Equipment Div., South Main St., Lima, Ohio
California, La Mirada: 14120 East Rosecrans Ave.
Georgia, Atlanta 18: P. O. Box 2561 Station D
Indiana, Michigan City: 2503 Lake Shore Dr.
Minnesota, Minneapolis: 2018 West 78 St.
New Jersey, Newark 5: 426 U.S. Highway No. 1
Texas, Dallas 7: 2356 Irving Blvd.
Washington, Seattle 4: 1932 First Av South

Barber-Greene Company, 400 North Highland Ave., Aurora, Ill.
Alabama, Birmingham: 512 North 18th St.
California, South San Francisco: 320 Victory Ave.
Florida, Orlando: 711 Magnolia Ave.
Illinois, Chicago 6: 9 South Clinton St.
Massachusetts, Needham Heights 94: 57 Crawford St., P.O. Box 98
Minnesota, Minneapolis: 5605 Lyndale Ave., South
New York, New York 17: 441 Lexington Ave.
Texas, Dallas 6: 4515 Prentice St.

Bechtel Corp., 220 Bush St., San Francisco 4, Calif.
California, Vernon: 4620 Seville Ave.
New York, New York 17: 485 Lexington Ave.
Texas, Houston 2: 1300 Main St.
Canada, Toronto 1, Ont.: 25 King St. West
Canada, Montreal 9, Que.: 5595 Pare St.
England, London W1: Time and Life Bldg.
France, Paris 8e: 37 Avenue Pierre 1e de Serbie

Bethlehem Steel Co., Bethlehem, Pa.
Arizona, Phoenix: 1219 Guaranty Book Bldg., 3550 N. Central Ave.
California, Los Angeles 54: 6000 So. Boyle Ave., Vernon, Box 2057 Terminal Annex
California, San Francisco 19: Bethlehem Bldg., 100 California St., Box 3494 Rincon Annex Station
Colorado, Denver 2: 815 First Nat'l. Bank Bldg.
Georgia, Atlanta 1: 1312 Fulton Nat'l. Bank Bldg., 55 Marietta St.
Illinois, Chicago 1: 2700 Prudential Bldg., Prudential Plaza
Illinois, Herrin: 500 W. Monroe St. Box 123
Kentucky, Louisville 16: 3321 Trinity Rd., Box 301
Maryland, Baltimore 3: Commercial Credit Bldg., 300 St. Paul Place, Box 388
Massachusetts, Boston 10: 75 Federal St.
Michigan, Detroit 2: General Motors Bldg., 3044 West Grand Blvd.
Minnesota, St. Paul 1: First Nat'l. Bank Bldg., 332 Minnesota St.
Missouri, St. Louis 5: S. Central & Bonhomme Aves.
New York, Albany 7: National Savings Bank Bldg., 90 State Street
New York, Buffalo 3: 10 Lafayette Square
New York, New York 2: 375 Park Ave.
Ohio, Cincinnati 2: 1401 Fifth Third Bank Bldg., 4th & Walnut Sts.
Ohio, Cleveland 13: 2700 Terminal Tower, 50 Public Square
Oregon, Portland 5: 1010 S. W. Fourteenth Ave.
Pennsylvania, Johnstown: Bethlehem Bldg., 119 Walnut St.
Pennsylvania, Philadelphia 3: 1058 Suburban Sta. Bldg., 1617 Penna. Blvd.
Pennsylvania, Pittsburgh 22: 1200 Oliver Bldg., Mellon Square
Texas, Houston 1: 7100 Clinton Dr., Box 2966
Washington, Seattle 4: 4045 Delridge Way
West Virginia, Bluefield: 2415 Bland Rd.
West Virginia, Charleston: 900 Chappel Road, S.E.
Canada, Montreal: Dominion Square Bldg.
Canada, Toronto: 170 University Ave.

Birdsboro Corporation, Birdsboro, Pa.

Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.
California, Los Angeles 22: 3043 South Tanager Ave.
Georgia, Atlanta 10: 680 Murphy Ave. S. W.
Illinois, Melrose Park: 2045 North 15th Ave.
New Jersey, Teterboro: 270 North St.
Texas, Houston 29: 8830 Market Street Rd.
Washington, Seattle 8: 655 South Edmunds St.

J. G. Blount Co., Everett 49, Massachusetts

Boulder Scientific Co., 250 Pearl St., Boulder, Colorado

Boyles Bros. Drilling Co., Ltd., 1291 Parker St., Vancouver, B. C.

Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill.
Alabama, Birmingham: 5 18th St., S.W.
California, Los Angeles: 2425 E. 37th St.
California, Sacramento: 7500 14th Ave.
New Mexico, Albuquerque: 2224 Broadway, S.E.
New York, Long Island City: 43-11 Eleventh St.
North Carolina, Asheville: Sweeten Creek Rd.
Pennsylvania, Philadelphia: 2514 E. Cumberland St.
Texas, Dallas: 150 Leslie St.
Washington, Seattle: 2600 1st Ave. & Vine
Washington, Yardley: 5311 E. Railroad Ave.
Canada, Lachine, P. Q.: 2280—43rd Ave.

Bucyrus-Erie Co., South Milwaukee, Wis.
California, South San Francisco: 120 Freeway St., P. O. Box 626
Arixona, Phoenix: 716 South 7th St., P. O. Box 4425
Georgia, Atlanta 3: 1508 William-Oliver Bldg., 32 Peachtree St.
Illinois, Chicago 3: 3100 Bankers Bldg., 105 West Adams St.
New York, New York 20: Suite 2030, General Dynamics Bldg., One Rockefeller Plaza
Pennsylvania, Pittsburgh 22: 1 Gateway Center-Room 732
Canada, Ontario, Toronto 9: 2489 Bloor St., West

Buell Engineering Co., 123 William St., New York 38, N.Y.
Cleveland 2, Ohio: Buell Engineering Co. Inc., Northern Blower Division, 6409 Barberton Ave.

C

Card Iron Works, C. S., 2501 West 16th Ave., Denver 4, Colo.

Caterpillar Tractor Co., Peoria, Ill.

Chain Belt Co., P.O. Box 2022, Milwaukee 1, Wisconsin
Alabama, Birmingham 4: S. L. Morrow Eng. Co., 113 North 9th St.
California, Los Angeles (Pico Rivera): 8300 Rex Rd.
California, San Francisco: 2940 Seventh St. (Berkeley 10)
Colorado, Denver 2: 110-16th St.
Florida, Jacksonville: 1641 Haswell St.
Georgia, Atlanta: 1788 Ellsworth Indust. Dr. N.W.
Illinois, Chicago: 2701 W. Peterson Ave.
Illinois, Moline: 1630 Fifth Ave., P.O. Box 353
Maryland, Baltimore 18: 1115 East 30th St.
Massachusetts, Boston 10: 10 High St.
Michigan, Grand Rapids 7: L. H. Flaherty Company, 638 Griggs St., S.E., P.O. Box 877M
Michigan, Detroit 38: 10600 Puritan Ave.
Minnesota, Minneapolis 16: 3033 Excelsior Bldg.
Missouri, Kansas City 11: 406 West 34 St.
Missouri, St. Louis 5: 8000 Bonhomme
New Jersey, East Orange: 19 North Harrison St.
New York, Buffalo 7: 1807 Elmwood Ave., Rooms 104 and 106
New York, New York 6: 19 Rector St., Room 1205
North Carolina, Charlotte 3: 300 Clanton Rd., P.O. Box 3732, Dilworth Station
Ohio, Cincinnati (Woodlawn): 10488 Chester Rd.
Ohio, Cleveland 13: 550 Terminal Tower Bldg., 60 Public Square
Oklahoma, Oklanoma City: 201 Leonhardt Bldg., 228 N.W. 2nd
Oregon, Portland 10: 2310 N.W. 24 Ave.
Pennsylvania, Philadelphia 24: 4125 Whitaker Ave.
Pennsylvania, Pittsburgh 34: 300 Mt. Lebanon Blvd.
Texas, Dallas 7: 8601 Soverign Row, P.O. Box 10167
Texas, Houston: 2333 Gulf Terminal Dr., P.O. Box 18596
Utah, Salt Lake City: 10 Exchange Place, 501 Newhouse Bldg.
Washington, Seattle 4: 2425 Airport Way
Wisconsin, Appleton: 1123 Irving Zuelke Bldg., 103 West College Ave.
Wisconsin, Milwaukee 14: 4532 West Greenfield Ave.
Canada, Montreal: 3405 Addington, Ave., Room 103, Montreal, Quebec
Canada, Toronto: 1181 Sheppard Ave. E., P.O. Box 130, Willowdale, Ontario

Charcoal Retort & Equipt. Co., P. O. Box 214, Spruce Pine, N. C.

The Chase Manhattan Bank, 1 Chase Manhattan Plaza, New York 5, N. Y.

Cheatham Electric Switching Device Co., 4780 Crittenden Drive, Louisville 9, Ky.
Utah, Salt Lake City 15: Western Sales Engineering Co., 18 East Stratford Ave.

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Alabama, Birmingham: 810 Fifth Ave. North
California, Los Angeles 22: 6935 Bandini Blvd.
California, South San Francisco: 145 Mitchell Ave.
Colorado, Denver 4: 465 Acoma St.
Illinois, Chicago 19: 936 East 87th St.
Missouri, St. Louis 3: 1931 Washington Ave.
Missouri, St. Louis 17: 8029 Litzsinger Rd.
New York, New York 17: 6 E. 44th St.
Ohio, Cincinnati 29: 4511 Reading Rd.
Ohio, Cleveland 14: 1643 Superior Ave.
Pennsylvania, Pittsburgh 13: 369 Coltart St.
Pennsylvania, Wynnewood: 312 E. Lancaster Ave.
Utah, Salt Lake City 1: 156 West Fourth South
Washington, Seattle 4: 2901 First Ave. South

Christensen Diamond Products Co., 1937 South 2nd West, Salt Lake City, Utah

Clark Bros. Div., Dresser Industries, Inc., P. O. Box 560, Olean, N. Y.
Arizona, Phoenix: P. O. Box 6104
California, Los Angeles 7: 235 West 32nd St.
California, San Francisco 3: 114 Fourteenth St.

Colorado, Denver 4: 475 Acoma St.
Florida, Winter Park: P. O. Box 152, 122 East Morse Blvd.
Illinois, Chicago 43: 10340 South Western Ave.
Louisiana, New Orleans 24: 5534 Canal Blvd.
Massachusetts, Boston 11: 183 Essex St.
Michigan, Detroit 2: 332 Curtis Bldg., 2842 West Grand Blvd.
Minnesota, Minneapolis 2: 746 Builders Exchange
Missouri, Kansas City 4: 7341 Broadway
Missouri, St. Louis 8: 4526 Olive St.
New York, New York 17: 144 East 44th St.
New York, Niskayuna: P. O. Box 137
New York, Syracuse 2: 605 Eckel Theater Bldg.
North Carolina, Charlotte 4: P. O. Box 4297, 1900 E. 7th St.
Oregon, Portland 14: 1225 S. E. Madison
Pennsylvania, Lancaster: 134 E. King St.
Pennsylvania, Pittsburgh 16: 3015 W. Liberty Ave.
Pennsylvania, Wynnewood: 331 E. Lancaster Ave.
Tennessee, Chattanooga 2: 1128 James Bldg.
Tennessee, Knoxville: P. O. Box 1363
Utah, Salt Lake City 1: 233 South West Temple
Washington, Seattle 44: 861 Poplar Place
Canada, British Columbia, West Vancouver: 560 Stevens Drive
Canada, New Brunswick, Fredericton: P. O. Box 1086, Central Trust Bldg., Queen St.
Canada, Ontario, Toronto 3: 50 Abell St.
Canada, Quebec, Westmount, Montreal 6: 164 Metcalfe Ave.
Newfoundland, St. John's: P. O. Box H-237, Johnston Insurance Bldg., 95 Elizabeth Ave.
Nova Scotia, Halifax: P. O. Box 1530, 4 Atlantic St.
Nova Scotia, Sydney: P. O. Box 386, 125 Shandwick

Coates Steel Products Co., Greenville, Ill.

The Colorado Fuel & Iron Corp., Continental Oil Bldg., Denver 2, Colorado

Connellsville Corporation, S. Fourth St., P.O. Box 677, Connellsville, Pa.
Alabama, Birmingham 3: 2313 Sixth Ave., South
Michigan, Iron Mountain—Champion, Inc.
Texas, El Paso: 1901 Bassett Ave., P.O. Box 226
West Virginia, Bluefield: 709 Albemarle St.

Coors Porcelain Co., 600 Ninth St., Golden, Colorado

Coppus Engineering Corp., Worcester 10, Mass.

Crucible Steel Co. of America, Gateway No. 4, Pittsburgh 22, Pa.
California, Los Angeles 22: 6033 E. Bandini Blvd.
California, San Francisco 10: 2050 Bryant St.
Colorado, Denver 16: 6301 Dexter St.
Georgia, Atlanta: 3400 Malone Dr., Chamblee
Massachusetts, Boston 54: Waltham Industrial Center, 45 1st Ave., Waltham, Mass.
Missouri, St. Louis 14: 8610 Page Blvd.
Minnesota, Minneapolis 14: 2911 Como Ave., S.E.
New Jersey, West Caldwell: P.O. Box 556
Oregon, Portland 10: 2330 N. W. Raleigh St.
Pennsylvania, Philadelphia: 408 S. Oak Ave., Primos
Pennsylvania, Pittsburgh 5: P.O. Box 4514
Utah, Salt Lake City: 753 W. 8th St., S.
Washington, Seattle 4: 2755 First Ave. South
Canada, Sorel, Quebec: Crucible Steel of Canada Ltd.

Cummins Engine Co., Inc., Columbus, Indiana
California, Los Angeles: Suite 1032, IBM Bldg.
California, San Francisco 4: Suite 435 Van Ness Post Center, 1225 Post St.
Colorado, Denver 2: 219 Ross Bldg.
Georgia, Atlanta 5: 359-61 E. Paces Ferry Rd., N.E.
Illinois, Chicago 3: 806 Willoughby Tower
Missouri, St. Louis 3: 707 Shell Bldg.
New York, New York: 375 Park Ave.
Ohio, Cleveland 14: 501 Fidelity Bldg.
Texas, Fort Worth 2: 1804 Fair Bldg.
Washington, Seattle 1: 935 Securities Bldg.
Canada, Toronto 9: 2489 Bloor St., W.

D

Dayton Industrial Products Co., Div. Dayco Corp., 2001 Janice Avenue, Melrose Park, Illinois
California, Los Angeles 11: 909 East Slauson Ave.
Georgia, Atlanta: 1040 Boulevard, S.E.
New Jersey, Linden: 3401 Tremley Point Rd.
Ohio, Cincinnati 37: 7730 Reinhold Dr., P. O. Box 2582
Texas, Dallas 7: 1300 Crampton St.

Deister Concentrator Co., Inc., 903 Glasgow Ave., Fort Wayne, Ind.
Alabama, Birmingham: 2612 N. 24th St.
California, Los Angeles: 2020 Sacramento St.
New York, New York 4: 60 Beaver St.
Pennsylvania, Nesquehoning: 35 E. Center St.

Deister Machine Co., 1933 East Wayne St., Fort Wayne 4, Indiana

Denver Equipment Co., 1400 17th St., P. O. Box 5268, Denver 17, Colorado
New York, New York City: Empire State Bldg.
West Virginia, Bluefield: P. O. Box 1536
Canada, Toronto, Ont.: 185 Bay St.
Canada, Vancouver, B. C.: Credit Foncier Bldg.
England, London, EC2: 15/17 Christopher St., Finsbury Square
Mexico, Mexico City: 14 Juarez Avenida
Peru, Lima: 270 Marquinarias, 4950 Casilla
South Africa, Johannesburg: Bez Valley

Detroit Diesel Engine Division, General Motors Corporation, 13400 West Outer Drive, Detroit 28, Michigan
California, San Francisco 4: 1426 Russ Bldg., 235 Montgomery St.
Georgia, Atlanta 5: Suite 2-A, 359 E. Paces Ferry Rd., N. E.
Illinois, Chicago 6: 110 North Wacker Dr.
Michigan, Wayne: 36501 Van Born Rd.
New York, New York 19: 1320 Coliseum Office Bldg., 10 Columbus Circle
Texas, Dallas 4: 105 Sanford-Maple Bldg., 2818 Maple Ave.

Diamond Tool Research Co., Inc., 380 Second Ave., New York 10, N.Y.
California, Los Angeles: 220 West 5th St., Western Division

Diesel Energy Corp., 82 Beaver St., New York, N. Y.

Differential Co., Box 238, Findlay, Ohio

Differential Steel Car Co., Findlay, Ohio

Dings Magnetic Separator Co., 4740 West Electric Ave., Milwaukee 46, Wisc.

Dorr-Oliver Incorporated, 77 Havemeyer Lane, Stamford, Conn.
California, Los Angeles 17: 811 W 7th St.
California, Oakland 1: 2900 Glascock St.
Colorado, Denver: P.O. Box 149 (Englewood)
Georgia, Atlanta: 900 Peachtree St., N.E.
Illinois, Chicago 54: 813 Merchandise Mart
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Pennsylvania, Pittsburgh 27: 4209 Clairton Blvd.
Texas, Dallas 25: 6115 Berkshire Lane
Washington, Seattle 99: 420 First Avenue West

Dow Chemical Co., Abbott Road Bldgs., Midland, Michigan

Ducon Company, Inc., 153 E. 2nd St., Mineola, L. I., N. Y.
Canada, Burlington, Ontario: 1131 Pettit St.

du Pont de Nemours & Co., Inc., E. I. Textile Fibers Department, 191 South Main Street, Akron 8, Ohio

E

Eimco Corp., 634 South 4th St. West, Salt Lake City 10, Utah
Alabama, Birmingham 9: Montgomery Highway, Vestavia Hills P. O. Box 6047
California, So. San Francisco, 115 Harbor Way
California, San Mateo: 420 Peninsular Ave.
Illinois, Palatine: 301 S. Hicks Rd.
Minnesota, Duluth 12: 1823 E. Superior St.
New York, New York 5: 52 South St.
Ohio, Cleveland: 334 Union Bldg., 1836 Euclid Ave.
Pennsylvania, Pittsburgh 5: P.O. Box 666-A, R.D. 5
Texas, El Paso: 1225 Mills Bldg.
Canada, Eimco Process of Canada, Ltd., 14 Raitherm Road, Toronto 19, Ontario, Canada
Canada: 1000 Wellington Street, Montreal 3, Quebec
France, Societe Eimco, 2, Rue de Clichy, Paris 9e, France
Italy, Eimco Italia, S.p.A., Via Finocchiaro Aprile 14, Milan, Italy
Northern Rhodesia, Eimco (Central Africa) (Private) Ltd., P.O. Box 885, Ndola, Northern Rhodesia
Southern Rhodesia, Eimco (Central Africa) (Private) Ltd., P.O. Box 2863, Salisbury, Southern Rhodesia
Union of South Africa, Eimco (South Africa) Pty., Ltd., P.O. Box 11286, Johannesburg, South Africa
United Kingdom, Eimco (Great Britain) Ltd., Team Valley, Gateshead-on Tyne 11, County Durham, England
England: Princes House, 190, Piccadilly, London W.1

Elektrokemisk, A. S., 101 Park Ave., New York, N.Y.

Ellicott Machine Corp., 1611 Bush St., Baltimore 30, Md.
California, San Francisco 5: Room 510 Underwood Building, 525 Market St.

Ensign-Bickford Co., 660 Hopmeadow St., P.O. Box 308, Simsbury, Conn.

Equipment Engineers Inc., 737 Loma Verde Ave., Palo Alto, Calif.

Eriez Manufacturing Co., P.O. Box 178, Glenside, Pa.
Colorado, Denver 18: 847 East 17th Ave.
Minnesota, Minneapolis 8: 2910 Lyndale Ave. South
Missouri, St. Louis 20, 4829 Goodfellow
Ohio, Cincinnati 15: 730 Brooks Ave.
Pennsylvania, Pittsburgh 20: One Parkway Center, 875 Greentree Rd.
Utah, Salt Lake City 10: 545-585 West Eighth South St., P.O. Box 209
Washington, Seattle 9: 418 Eighth Ave., North
Canada, Ontario, Toronto 17, 1723a Bayview Ave.

Euclid, Div. of General Motors Corp., Hudson, Ohio
California, Oakland 12: Room 660, El Dorado Bldg., 360 22nd St.
Georgia, Atlanta 5: Suite 3-H Luckie Bldg., 361 E. Paces Ferry Road, N.E.
Missouri, Kansas City: 702 V F W Bldg., 406 West 34th St.
New York, N. Y. 17: Room 901, 295 Madison Ave.

Exide Industrial Mktg. Div., Electric Storage Battery Co., Rising Sun & Adams Ave., Philadelphia 20, Pa.
Georgia, Atlanta 10: 1246 Allene Ave., S.W.
Illinois, Chicago 9: 5335 S. Western Blvd.
Ohio, Cleveland 14: 2225 Hamilton Ave.
Texas, Dallas 19: P.O. Box 6933
Michigan, Detroit 27: 14965 Schaefer Highway
Mo., Kansas City 23: 129 S. Belmont Blvd.
California, Los Angeles 15: 1043 S. Grand Ave.
Wisc., Milwaukee 2: 312 E. Wisconsin Ave.
Pa., Pittsburgh 12: 2242 California Ave.
Mo., St. Louis 10: 5120 Northrup Ave.
California, San Francisco 24: 6150 Third St.
Washington, Seattle 1: 500 Wall St.
New York, Syracuse 2: 217 Montgomery St.
Washington 16, D.C.: 4000 Albemarle St., N.W.

F

Falk Corp., Box 492, Milwaukee 1, Wis.
Alabama, Birmingham 3: Rm. 649, Brown-Marx Bldg.
California, Los Angeles 22: P.O. Box 22049
California, San Francisco 7: 427 Bryant St.
Colorado, Denver 3: 655 Broadway Bldg.
Illinois, Chicago 3: 105 W. Adams St.
Illinois, Peoria: 800 S. W. Adams St.
Minnesota, Minneapolis 16: 5009 Excelsior Blvd.
Missouri, St. Louis 5: 8029 Forsyth Blvd.
New York, New York 17: 200 East 42nd St., Room 2800
Ohio, Cleveland 24: P.O. Box 4506
Pennsylvania, Philadelphia: P.O. Box 313—Wynnewood
Pennsylvania, Pittsburgh 34: 300 Mt. Lebanon Blvd., Suite 200B
West Virginia, Charleston 2: P.O. Box 1068
Wisconsin, Milwaukee 1: Box 492

Fate-Root-Heath Co., Plymouth Locomotive Works Div., Plymouth, Ohio
California, San Francisco 7: McCormick-Morgan Co., 324 Fifth St.
Colorado, Denver 2: Toncrav Equipment Company, 1732 Blake St.
Missouri, St. Louis 3: The Ross Company, 3310 Olive St.
West Virginia, Huntington 6: Banks-Miller Supply Co., 330 Third Ave.

Firestone Tire & Rubber Co., 12 S. Main St., Akron 12, Ohio

Flexaust Co., 100 Park Ave., New York 17, N.Y.

Flexible Steel Lacing Co., 4607 Lexington St., Chicago 44, Ill.
California, San Mateo: 10 Jody Court
Connecticut, Fairfield: 139 Short Hill Lane
Georgia, Atlanta 19: 1224 Spring Mill Court
Illinois, Wheaton: RFD 2, Box 25, Orchard Rd.
Indiana, Indianapolis 20: 1006 Chevy Chase Lane
Minnesota, Wayzata: Route 1, Box 34
Missouri, Kansas City 13: 630 Huntington Rd.
North Carolina, Greensboro: 1510 Guest St.
Ohio, Vermilion: Portage Dr., Vermilion Lagoons
Pennsylvania, Springfield, Del. Co., 490 Kerr Lane
Texas, Dallas 8: 1330 Hollywood Ave.
Washington, Seattle 77: 2403 W. 197th St.
Canada, Ontario, Toronto 12: 54 Mason Blvd.

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Ford Div., For Motor Co., Rotunda Drive & Southfield, Dearborn, Michigan

Foxboro Co., Foxboro, Mass.
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Colorado, Denver 6: 2829 E. 2nd Ave.
Pennsylvania, Pittsburgh 5: 2270 Noblestown Rd.
Utah, Salt Lake City 15: 2520 South State St.
West Virginia, Charleston 1: 309 Nelson Bldg.

Fuller Transmission, Div. of Eaton Manufacturing Co., Prouty St., Kalamazoo, Michigan

G

Gardner-Denver Corp., Quincy, Ill.
California, Los Angeles 22: 7654 E. Slauson Ave.
California, San Francisco 7: (South San Francisco) 144 West Harris Ave.
Colorado, Denver 1: 1727 E. 39th Ave P.O. Box 1020
Idaho, Wallace: Samuels Hotel Bldg., 408 7th St., P.O. Box 788
Louisiana, New Orleans 25: 7735 Edinburgh St., P.O. Box 13155
Minnesota, Duluth 2: 521 East Superior
Missouri, Kansas City 14: 309 W. 79 Terrace
Missouri, St. Louis, Hazelwood: 6011 N. Lindbergh Blvd.
Montana, Butte: 215 E. Park St.
New Jersey, Teterboro: 700 Huyler St.
New York, Buffalo 26: 4532 Bailey Ave.
Ohio, Cleveland 11: 3088 W. 117th St.
Pennsylvania, Philadelphia 40: 4309-11 Rising Sun Ave.
Pennsylvania, Pittsburgh 26: 520 McNeilly Rd.
Texas, El Paso: 1704 E. Paisano Drive
Texas, Dallas 35: 7125 Harry Hines Blvd., P.O. Box 35106
Utah, Salt Lake City: 113 W. Second South St.
Washington, Seattle 4: 615 Eighth Ave. South
Australia, Artarmon, N.S.W.: 70 Hotham Parade
Canada, Edmonton, Alberta: 14415-114
Canada, Moncton, New Brunswick: E. Main St., P.O. Box 475
Canada, Montreal 28, Quebec: 5825 St. James St., W.
Canada, Nelson, B. C.: 745 Baker St.
Canada, Toronto 16, Ontario: 14 Curity Ave.
Canada, Vancouver 9, B.C.: 1775 Pine
Canada, Winnipeg 3, Manitoba: 1370 Sargent Ave.
Northern Rhodesia, Ndola: P. O. Box 18, 2nd St.
Mexico, Mexico City 6, D. F.: Apartado 575
South America, Lima, Peru: Apartado 674
South America, Rio de Janeiro, Brazil Avenida Churchill 94-B, Caixa Postal 4293
Union of S. Africa: Johannesburg Transvaal: P.O. Box 4807

General American Transportation Corp., 135 South La Salle St., Chicago 90, Ill.
Alabama, Birmingham: P.O. Box 1870
California, Los Angeles 17: 900 Wilshire Blvd.
California, San Francisco 4: 235 Montgomery St.
Louisiana, New Orleans 12: 210 Baronne St.
Missouri, St. Louis 1: 915 Olive St.
New Jersey, Clifton: Parker-Kalon Div.
New York, Buffalo 3: 2008 Rand Bldg.
New York, New York 17: 380 Madison Ave.
Ohio, Cleveland 13: 1307 Terminal Tower Bldg.
Oklahoma, Tulsa: 1005 First National Bank Bldg.
Pennsylvania, Pittsburgh 19: 2612 Koppers Bldg.
Texas, Dallas 2: First National Bank Bldg.
Texas, Houston 2: 919 Bank of the Southwest Bldg.
Utah, Salt Lake City: (Orem Plant) P.O. Box 97, Orem, Utah
Washington, Seattle: 1328 Washington Bldg.

General Electric Co., 1 River Road, Schenectady, N. Y.
Alabama, Birmingham 3: 1804 Seventh Ave., N.
Arizona, Phoenix: 220 Luhrs Tower
California, Los Angeles 54: 212 N. Vignes St.
California, San Francisco 6: 235 Montgomery St.
Colorado, Denver 6: 201 University Blvd.
Florida, Jacksonville 6: 1901 Hill St.
Florida, Miami 32: 25 S. E. Second Ave.
Florida, Tampa 9: 2106 S. Lois Ave.
Georgia, Atlanta 3: 1860 Peachtree Rd., N.W.
Idaho, Boise: 1524 Idaho St.
Illinois, Chicago 80: 840 S. Canal St.
Indiana, Evansville 5: 312 N.W. Seventh St.
Indiana, Indianapolis 8: 3750 N. Meridian St.
Kentucky, Lexington: 628 E. Main St.
Kentucky, Louisville 2: 1216 Starks Bldg.
Louisiana, New Orleans 12: 837 Gravier St.
Massachusetts, Boston 1: 31 St. James Ave.
Michigan, Detroit 2: 700 Antoinette St.
Michigan, Saginaw: Second Nat'l Bank Bldg.
Minnesota, Duluth 2: 14 W. Superior St.
Minnesota, Minneapolis 3: 12 S. Sixth St.
Missouri, Joplin: 220½ W. Fourth St.
Missouri, Kansas City 5: 106 W. 14th St.
Missouri, St. Louis 1: 818 Olive St.
Montana, Billings: 303 N. Broadway
Montana, Butte: 103 N. Wyoming St.
Nebraska, Omaha 2: 409 S. 17th St.
New Mexico, Albuquerque: 120 Madeira Drive, N.E.
New York, Albany 3: 8 Colvin Ave.
New York, New York 22: 750 Lexington Ave.
New York, Syracuse 6: 3532 James St.
North Carolina, Charlotte 1: 112 S. Tryon St.
Ohio, Cincinnatti 6: 2621 Victory Pkwy.
Ohio, Cleveland 4: 4966 Woodland Ave.
Ohio, Columbus 15: 395 East Broad St.
Ohio, Youngstown 7: 272 E. Indianola Ave.
Oklahoma, Oklahoma City 2: 119 N. Robinson St.
Oklahoma, Tulsa 3: 320 S. Boston Ave.
Oregon, Portland 10: 2929 N. W. 29th Ave.
Pennsylvania, Allentown: 732 North 16th St.
Pennsylvania, Erie 2: 1001 State St.
Pennsylvania, Philadelphia 2: 3 Penn Center Plaza
Pennsylvania, Pittsburgh 22: The Oliver Bldg., Mellon Sq.
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Tennessee, Memphis 4: 19 South Cleveland St.
Tennessee, Nashville 3: 1717 W. End Bldg.
Texas, Dallas 22: 8101 Stemmons Freeway
Texas, El Paso: 215 N. Stanton
Texas, Houston 27: 4219 Richmond Ave.
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Washington, Seattle 4: 710 Second Ave.
Washington, Spokane 4: S. 162 Post St.
West Virginia, Bluefield: 704 Bland St.
West Virginia, Fairmont: 310 Jacobs Bldg.
West Virginia, Wheeling: 40 14th St.
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Wisconsin, Milwaukee 3: 940 W. St. Paul Ave.

General Refractories Co., 1520 Locust St., Philadelphia, Pa.
Alabama, Birmingham 3: 1008 Frank Nelson Bldg., 2nd Ave. & 20th St. North
California, Los Angeles 58: 3247 Fruitland Rd.
California, San Francisco 5: 770 Monadnock Bldg., 681 Market St.
Illinois, Chicago 4: 208 S. La Salle St.
Indiana, Indianapolis 4: 806 Board of Trade Bldg., 143 N. Meridian St.
Kentucky, Ashland: 921 Second National Bank Bldg., 1556 Winchester Ave.
Michigan, Detroit 4: 7640 W. Chicago Blvd.
Missouri, St. Louis 5: 210 Slavin Bldg., 8000 Bonhomme Ave.
New York, Buffalo 3: 1428 Rand Bldg., 14 Lafayette Square
New York, New York 36: 11 West 42nd St.
Ohio, Cleveland 13: 1936 The Illuminating Bldg. 55 Public Square
Pennsylvania, Pittsburgh 19: 2101 Law & Finance Bldg. 429 Fourth Ave.

Goodrich Tire Co., B. F., Div. of B. F. Goodrich Co., Akron 18, Ohio
Alabama, Birmingham 5: 101 S. 12th St.
California, Los Angeles 54: 3525 S. Garfield Ave., P.O. Box 2002, Terminal Annex
California, San Francisco 24: 1950 Army St., P.O. Box 162
Colorado, Denver 4: 2500 W. 8th Ave., P.O. Box 417
Florida, Jacksonville: 2252 Dennis St., P.O. Box 2430
Georgia, Atlanta 7: 1721 DeKalb Ave., N.E., P.O. Box 4509
Illinois, Chicago 44: 4646 W. Lake St.
Kansas, Kansas City 15: 830 Kindelberger Rd.
Maryland, Baltimore 2: 1266 E. North Ave.
Michigan, Grand Rapids 7: 6 Stuart St., S.W.
Minnesota, Minneapolis 16: 800 Turner's Crossroad So.
Missouri, St. Louis 14: 1975 Walton Rd.
New York, Albany 1: 1043 Broadway
New York, Buffalo 9: 1050 Main St.
New York, New York 17: 230 Park Ave.
North Carolina, Charlotte: Hovis Rd., P.O. Box 2755
Ohio, Cincinnati 41: 2929 Exon Drive
Ohio, Cleveland 35: 15593 Brookpark Rd.
Ohio, Columbus 14: 3770 Indianola Ave.
Oklahoma, Oklahoma City: 301 E. Hill St.
Oregon, Portland 10: 4600 N.W. St. Helens Rd.
Pennsylvania, Philadelphia 34: 955 E. Erie Ave., P.O. Box 4743
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Utah, Salt Lake City 15: 1721 South 450 W.
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Goodyear Tire & Rubber Co., Akron, Ohio
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New York, New York 22: 400 Park Ave.
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North Carolina, Charlotte 8: 929-1029 Jay St., POB 2449
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Pennsylvania, Pittsburgh 13: 4760 Centre Ave.
Tennessee, Knoxville: POB 2188, 1005 Maryville Pike, SW
Tennessee, Memphis 9: 2070 3rd St.
Texas, Dallas 35: 7301 Ambassador Row
Texas, El Paso: 1331 Texas St.
Texas, Houston 20: 5544 Armour Drive
Texas, San Antonio 5: 613 North W.W. White Rd., POB 1269
Utah, Salt Lake City 1: 46 W. Fayette Ave., POB 2400
Virginia, Richmond 19: 219 S. 10th St.
Washington, Seattle 4: 1112 Airport Way, South
Washington, Spokane 4: North 112 Haven St.
West Virginia, Charleston 28: 812 Kanawa Blvd.
Wisconsin, Milwaukee 12: 3860 N 3rd St.

Greenville Steel Car Company, Earthmoving Equipment Division, Greenville, Pennsylvania

H

Halliburton Oil Well Cementing Co., 1015 Bois D'Arc St., Duncan, Oklahoma

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Canada, Ontario, Hamilton: 105 Walnut St., South
Canada, Quebec, Montreal 2: Room 540, Canada Cement Bldg.

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Illinois, Chicago 6: 1907 Engineering Bldg., 205 W. Wacker Dr.
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Pennsylvania, Pittsburgh: P. O. Box 10540

Hercules Powder Co., Hercules Tower, 910 Market St., Wilmington 99, Del.
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California, San Francisco 4: 120 Montgomery St.
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Utah, Salt Lake City 1: Kearns Bldg., 136 S. Main St.

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Huber-Warco Co., Marion, Ohio

Hughes Tool Co., 5425 Polk St., Houston 1, Texas

I

Industrial Physics & Electronics Co., 470 S. 10th St., Salt Lake City, Utah

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International Harvester Co., 180 North Michigan Ave., Chicago 1, Ill.
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Oklahoma, Tulsa 20: 510 E. Second St.
Tennessee, Memphis 4: 215 S. Pauline St.
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Texas, Houston 1: 4619 Navigation Blvd., P. O. Box 3050
Utah, Salt Lake City 10: 317 E. Fourth South St., P. O. Box 1445
Washington, Spokane 3: 715 E. Sprague Ave.

International Nickel Company, Inc., The, 67 Wall St., New York 5, N. Y.

Interstate Equipment Corporation 433 North Broad Street, Elizabeth 3, New Jersey
Pennsylvania, Pittsburgh 34: 300 Mt. Lebanon Blvd.

J

Jamison Feeder, Inc., Hunkers, Pa.

Jenkins Bros., 100 Park Ave., New York 17, N. Y.
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Pennsylvania, Philadelphia 4: 1624

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Missouri, St. Louis 10: 1203 Macklind Ave.
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Pennsylvania, Luzerne: 453 Main St.
Pennsylvania, Philadelphia 2: 1420 Walnut St.
Pennsylvania, Pittsburgh 16: 3021 Banksville Rd.
Tennessee, Knoxville 2: 108 W. Main St.
Texas, Dallas 20: 7425 Hines Blvd.
Texas, El Paso: 1022 Wyoming St.
Utah, Salt Lake City 4: 998 South Sixth West St.
Wash., Seattle 9: 422 First Ave. West
W. Va., Huntington: 742 Eighth Ave.

K

Kaiser Engineers, 300 Lakeside Dr., Kaiser Center, Oakland 12, Calif.
Illinois, Chicago 1: 228 North Lasalle St.
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Krupp International, Inc., 375 Park Avenue, New York 22, N. Y.

KW-Dart Truck Co., 1301 North Manchester Trafficway, Kansas City, Mo.
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Ohio, North Ridgeville, 34554 Lorain Rd.

L

Layton Co., 4749 S. Whitnall Ave., Cudahy, Wisc.

Le Roi Div., Westinghouse Air Brake Co., Sidney, Ohio
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Ohio, Cleveland 9: 4798 State Rd.
Oklahoma, Tulsa 19: Suite 307-A IBM Bldg., 1307 South Boulder
Ontario, Downsview: 465 Wilson Ave. West
Wisconsin, Milwaukee 13: Mayfair Office, 2500 N. 108th St. (Hwy. 100)

Leschen Wire Rope Division, H. K. Porter Company, Inc., 2727 Hamilton Ave., St. Louis 12, Mo.
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Illinois, Elk Grove: 2567 Greenleaf Ave.
New Jersey, Newark 5: 219 Emmet St.
Oklahoma, Oklahoma City 4: 216 S. Klein St.
Texas, Houston 3: 34 Jenkins St.

Letourneau-Westinghouse, P. O. Box 240, Peoria, Ill.
Utah, Salt Lake City: 1935 S. Main St. Suite 443

Linatex Corp. of America, Stafford Springs, Conn.
Illinois, Elmhurst: P. O. Box 481
Utah, Bountiful: 387 West 1050 North
Canada, Quebec, Montreal 9: 1975 Bois Franc Rd., Wilkinson Linatex Co.

Locke Steel Chain Co., Bridgeport, Conn.

Logan Engineering Co., 4901 West Lawrence Ave., Chicago 30, Ill.

Lug-All Company, Haverford, Pa.

Machinery Center, Inc., 1201 S. 6th West St., P. O. Box 964, Salt Lake City 1, Utah
Washington, Chelan: P. O. Box 762
Canada, Winnipeg, Manitoba: 416 Ave. Bldg.

M

Mack Trucks, 1355 West Front Street, Plainfield, N. J.
Alabama, Birmingham: 2820 Sixth Ave., So. (P. O. Box 1009)
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California, San Francisco: 1745 Folsom St.
Colorado, Denver: 4850 Vasquez Blvd.
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Kentucky, Louisville: 1820 Arthur St.
Louisiana, New Orleans: 1001 So. Jefferson Davis Pkway.
Michigan, Detroit: 10401 Ford Rd., Dearborn
Minnesota, St. Paul: 2505 University Ave. (Midway)
Missouri, Kansas City: 3738 Gardner Ave.
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Mayo Tunnel & Mine Equipment Co., Lancaster, Pa.

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The McNally Pittsburg Mfg. Corp., 307 West Third St., Pittsburg, Kansas
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Ohio, Wellston: P. O. Box 228.

Meehanite Metal Corp., 714 North Ave., New Rochelle, N. Y.

Meehanite Metal Corp., 106 S. Hanley Rd., St. Louis, Mo.
Foundries:
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California, Oakland: Vulcan Foundry Co.
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Texas, Corsicana: Oil City Iron Works
Washington, Seattle: Washington Iron Works
Washington, Spokane: Washington Machinery & Supply Co.
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England, Nottingham: Albert St.-Bulwell

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Missouri, St. Louis 3: 1915 Washington
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(Courtesy Moly Mountain News)

COMPLETED headframe on the new No. 5 shaft rises 128 ft above the collar. Sinking of the 640 ft deep shaft awaited only delivery of hoisting equipment.

Climax Prepares to Sink No. 5 Shaft

THE BEGINNING of sinking for the new Storke Level service shaft was to begin following delivery of equipment in May at Climax Molybdenum Co., Climax, Colo.

The new shaft, the No. 5, will transport personnel, mining and crushing equipment to the production level being developed 300 ft below the Storke Level. The shaft will be 23 ft, 4 in. in diameter, concrete lined, and will drop to a depth of 640 ft.

The 128-ft headframe is locked in a heavy concrete base. Initial preparation for the new shaft began June 28, 1960, with steel work first placed in November of that year. At the same time, a covered personnel tunnel was constructed to the mine dry to permit employees to enter the shaft directly.

In a companion development at Climax, the No. 4 shaft was bottomed out in February, and subsequent work was devoted to convert the shaft for ore haulage and transport of men and material. Skip loading pockets are being constructed for the operation of two hoists, with completion of construction and development of a production level due by mid-summer. Four stations, at 300, 329, 600 and 629 ft, have been cut and an exploration level at 600 ft has been begun.

In his report to the stockholders in New York in May, Walter Hochschild, chairman of the board of American Metal Climax, described the Climax work as the company's "largest investment program," to prepare the mine "for operation at maximum rates of output.

"Over a period of five years," he said, "we will invest nearly $40-million in the essential work of preparing the third level and necessary surface and other facilities to provide capacity production."

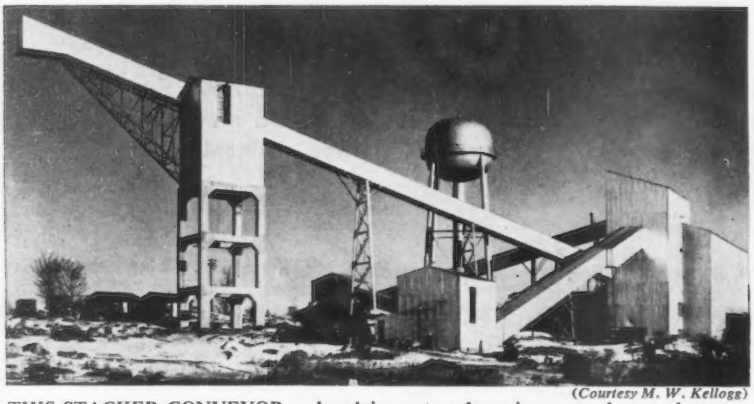
Mr. Hochschild also reported progress on other expansion and diversification programs.

Construction is on schedule at the new $7-million nitrate of potash plant at Vicksburg, Miss.

At Carlsbad, N. M., he stated, benefits are beginning to flow from the completion of part of the $3-million potash mine expansion program.

Construction is also proceeding on schedule at the company's new iron powder plant for the Pyron Division at Niagara Falls, N. Y., in which the company has invested approximately $3-million in the past year.

At the mining properties in Africa in which Amax has important interests, there are major programs underway, including the 50% expansion of the capacity of the Mufulira Mine in Northern Rhodesia which should be completed next year, a 20% expansion of the Chibuluma mine output to be completed in 1963, and at the Tsumeb mine in South West Africa, the construction of a copper smelter, a lead smelter and refinery, and the opening up of the new Asis mine and mill, which are scheduled for completion in 1962 and 1963.



(Courtesy M. W. Kellogg)

THIS STACKER CONVEYOR and reclaim system for primary crusher products are part of the current expansion at the Republic, Mich., iron ore beneficiation plant of Marquette Iron Mining Co. Expected capacity: 1.6-million tpy of concentrate.

AEC Signs $100-Million "Stretch-Out With UCC

THE AEC has completed stretchout contracting with Union Carbide Nuclear Co., wholly-owned subsidiary of Union Carbide Corp., covering sale of concentrates from firm's Rifle and Uravan mills in western Colorado.

The Government will buy about $100-million in such concentrates from April 1, 1961 to Dec. 31, 1966. Unit price prior to April 1, 1962 will be $8.41 a lb. After that (to Dec. 31, 1966) price will be at $8 a lb.

These contracts build in an "historic" approach to allocation of concentrates to be bought from ores of independent miners between April 1, 1962—Dec. 31, 1966. This approach would permit a 25% increase in concentrates procurement in that period if the ore reserves at the independent mines are sufficient to warrant such procurement. The contract also provides for acquisition of 900,000 lb of U_3O_8 from ores of the independents between April 1, 1962. Remaining procurement is on basis of concentrates from Carbide-controlled properties in the Uravan Mineral Belt.

AEC has now contracted for a total of 128.5-million lb of U_3O_8 in the post-'62 period. Estimated cost to the Government: slightly more than $1-billion.

YOUR

PROCESS

BECOMES

PRODUCTION

WITH STEARNS-ROGER

The plant that will effectively and economically implement your chemical or metallurgical process is one designed, engineered, erected, equipped and tested by Stearns-Roger engineers. Our service can save you months of lost time getting into production and avoiding trial and error in bringing operations up to design capacity. For over half a century Stearns-Roger plants have been known as the best that the technical skills can produce. When you begin to plan facilities, consult Stearns-Roger.

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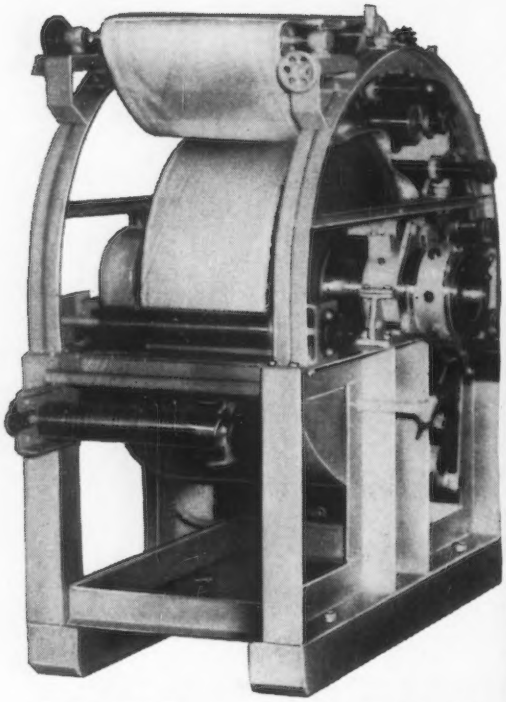
DENVER • HOUSTON • SALT LAKE CITY

Stearns-Roger Engineering Co., Ltd., Calgary

ENGINEERS • CONSTRUCTORS
MANUFACTURERS

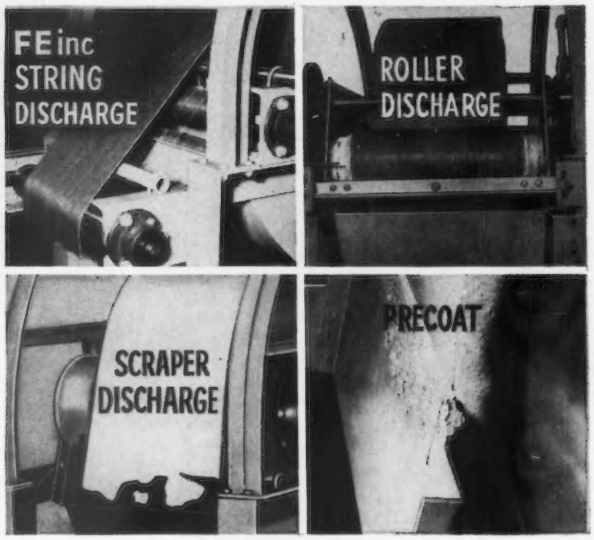
Which pilot plant filter do you need?

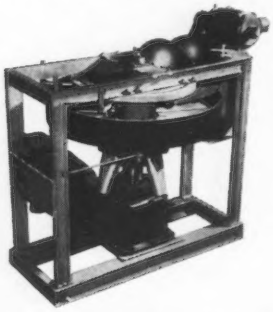


DRUM FILTER — String, scraper, roller, belt and precoat discharge can be tested on the extremely flexible FEinc Pilot Plant Drum Filter. Submergence washing and compression dewatering mechanism can be utilized if desirable. The 3 x 1 ft. size has 9.4 sq. ft. of filtering area and is constructed of Type 316 stainless steel. Smaller sizes available.

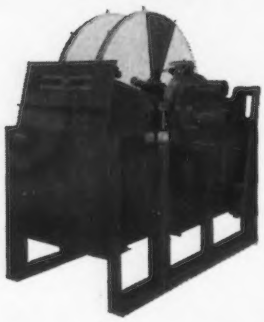
Eliminate the risk and unnecessary capital investment by scaling up from one of the seven Pilot Plant Filters offered by FEinc.

Available on a rental basis, these units allow you to determine optimum design and operation conditions for maximum filtering efficiency in your particular process. See our insert in Chemical Engineering Catalog, or write for bulletins or technical advice without obligation. Address Dept. EMF-661.





HORIZONTAL FILTER — FEinc can supply pilot models of both open and enclosed horizontal filters. 3 ft. diameter. Type 316 stainless steel. 7.6 sq. ft. filtering area.



DISC FILTER — FEinc Disc Filters for pilot plant work are also available. All FEinc pilot models are supplied with the filter cloth determined best for the application.

FE INC®

FILTRATION ENGINEERS DIVISION OF
American Machine and Metals, Inc.
East Moline, Illinois

Custom-designed continuous vacuum or pressure filters for better cake quality . . . lower costs . . . maximum filtering efficiency

C. P. KEEGEL, left, president of the company, with Robert Zuber, field superintendent at the project.

Leprechaun Mining Begins Large Lithia Development

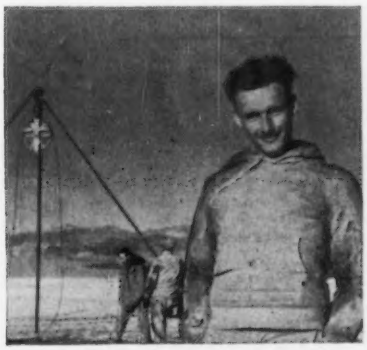
IMPORTANT PROGRESS is being made by Leprechaun Mining & Chemical Co. in development of a major lithia field near Silver Peak, Nev. The firm has collected gamma-neutron logging data and conducted exploration drilling in the dry lake bed and discovered two major brine deposits, one at depth and the other much shallower.

In its drilling of the "upper horizon" with shallow holes, Leprechaun has proved 800 ppm of Li_2O content and a lithia: potash ratio of 1:10. Reserves are estimated as follows (in tons):

	Li_2O	K_2O
Proven	52,107	523,000
Probable	125,365	1,255,000
Possible	102,400	1,025,000

The firm, headed by C. P. Keegel, who discovered the orebody, plans to cut 35 ft deep "slots" about a half mile long and pump the brines to settling ponds. The partly dewatered brines will then be treated in a plant using the Dow Patent Process to precipitate lithia with aluminum hydroxide.

Mr. Keegel, who participated in the development of the trona lands of Searles Lake Chemical Corp. and was engaged



CHIEF ENGINEER for exploration for the brines project is Gerhardt Pralle.

FEON® FILTER MEDIA

specialists in LIQUID SOLIDS separation

by Centrifugal Extraction • Pressure Leaf and Continuous Vacuum or Pressure Filtration • Filter Media

GENERIC NAME, DEFINITION AND TRADE NAMES OF MAN-MADE FIBERS

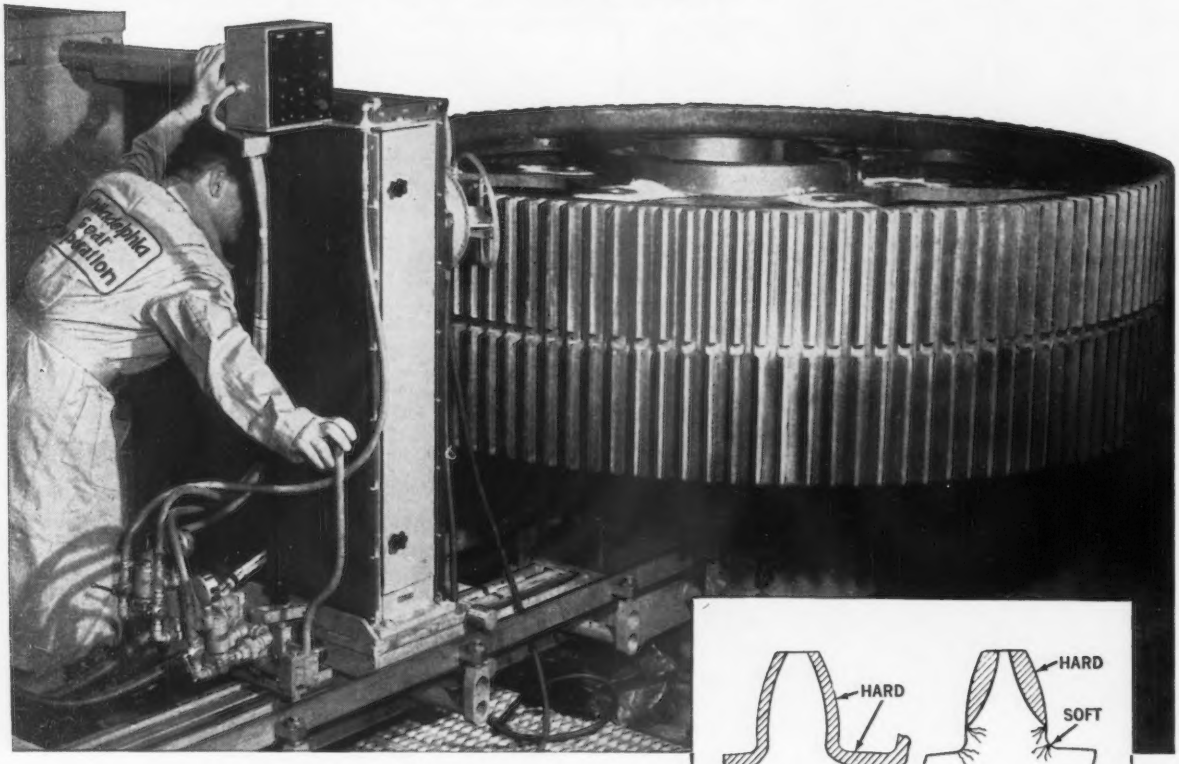
GENERIC NAME	FTC DEFINITION	TRADE NAME
Acetate	—a manufactured fiber in which the fiber-forming substance is cellulose acetate. Where not less than 92% of the hydroxyl groups are acetylated, the term triacetate may be used as a generic description of the fiber.	ACELE[13] CELANESE[5] ESTRON[13] Also made and sold under generic name by 4, 5, 6, 9, 21 & 25
Acrylic	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of acrylonitrile units (-CH_2-$\underset{CN}{CH}$-).	ACRILAN[9] CRESLAN[17] ORLON[13] ZEFRAN[11]
Azlon	—a manufactured fiber in which the fiber-forming substance is composed of any regenerated naturally occurring proteins.	No current commercial domestic production
Glass	—a manufactured fiber in which the fiber-forming substance is glass.	FIBERGLAS[26] Also made and sold under generic name by 14, 22 & 27
Metallic	—a manufactured fiber composed of metal, plastic-coated metal, metal-coated plastic, or a core completely covered by metal.	FILDOR[11] LUREX[16] METLON[10] RAYMET[10]
Modacrylic	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of less than 85% but at least 35% by weight of acrylonitrile units (-CH_2-$\underset{CN}{CH}$-).	DYNEL[13] VEREL[12]
Nylon	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polyamide having recurring amide groups (-$\overset{O}{\overset{\|}{C}}$-NH-) as an integral part of the polymer chain.	Made and sold under generic name by 2, 4, 8, 12 & 21
Nytril	—a manufactured fiber containing at least 85% of a long chain polymer of vinylidene dinitrile (-CH_2-$C(CN)_2$-) where the vinylidene dinitrile content is no less than every other unit in the polymer chain.	DARVAN[19]
Olefin	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of ethylene, propylene, or other olefin units.	AVISCOPE[3] REEVON[18] ROYALENE[18] WYNENE[24] Also made and sold under generic name by 20
Polyester	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of a dihydric alcohol and terephthalic acid (p-HOOC - C_6H_4 - COOH).	DACRON[13] KODEL[11] TERON[13] VYCRON[13]
Rayon	—a manufactured fiber composed of regenerated cellulose, as well as manufactured fibers composed of regenerated cellulose in which substituents have replaced not more than 15% of the hydrogens of the hydroxyl groups.	BEMBERG[9] CORDURA[13] CORVAL[9] FORTISAN[13] TYREX Also made and sold under generic name by 4, 5, 7, 21, 25 & 30
Rubber	—a manufactured fiber in which the fiber-forming substance is comprised of natural or synthetic rubber.	
Saran	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 80% by weight of vinylidene chloride units (-CH_2-CCl_2-).	Made and sold under generic name by 11, 16, 18 & 24
Spandex	—a manufactured fiber in which the fiber-forming substance is a long chain synthetic polymer comprised of at least 85% of a segmented polyurethane.	LYCRA[13] VYRENE[23]
Vinal	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 50% by weight of vinyl alcohol units (-CH_2-CHOH-), and in which the total of the vinyl alcohol units and any one or more of the various acetal units is at least 85% by weight of the fiber.	Limited production by 1
Vinyon	—a manufactured fiber in which the fiber-forming substance is any long chain synthetic polymer composed of at least 85% by weight of vinyl chloride units (-CH_2-CHCl-).	Made and sold under generic name by 5 & 31

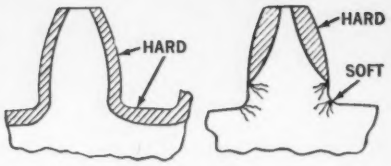
1 Air Reduction Chemical Co.
2 Allied Chemical Corp.
3 American Cyanamid Co.
4 American Enka Corp.
5 American Viscose Corp.
6 Bemberg Mills, Inc.
7 Celanese Corp. of America
8 Chemstrand Corp.
9 Courtaulds (Alabama) Inc.
10 Dobeckmun Co.
11 Dow Chemical Co.
12 E. I. du Pont de Nemours & Co., Inc.
13 Eastman Chemical Products, Inc.
14 Ferro Corp.
15 Fiber Industries, Inc.
16 Firestone Plastics Co.
17 Freydberg Bros.-Strauss
18 General Tire & Rubber Co.
19 B. F. Goodrich Chemical Co.
20 Hercules Powder Co., Inc.
21 Industrial Rayon Corp.
22 Johns-Manville Fiber Glass, Inc.
23 Monsanto Corp.
24 National Plastic Products Co.
25 North American Rayon Corp.
26 Owens-Corning Fiberglas Corp.
27 Pittsburgh Plate Glass Co.
28 Reeves Brothers, Inc.
29 Reynolds Metals Co.
30 Shenandoa Rayon Corp.
31 Union Carbide Chemicals Co.
32 U. S. Rubber Co.

FILTRATION FABRICS DIVISION
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS
FEON®

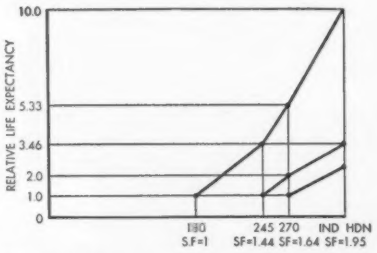
Free reprints of this chart sent upon request

New Philadelphia induction hardening increases life of large gear drives . . .





New Philadelphia full contour induction hardening (left) provides a continuous hardened area from one tooth flank around the root and up the other flank without interruption. There are no points of stress. Typical heat treated gear (right) shows inadequate hardening of root of tooth, a point of major stress.



This chart shows the relationship between load and gear life. Note that the improved service factor of a gear set may be used to substantially increase gear life, rather than to increase the load.

HERE'S WHY: Full tooth contour induction hardening of large gears provides a uniformly hardened surface from one tooth flank around the root and up the other flank without interruption. Eliminates points of thermal stress concentration. And there is no distortion, a problem of heat treated gearing that requires subsequent grinding.

This new, advanced Philadelphia method permits radical reduction in sizing and/or increased load carrying capacities. And it can easily harden even the largest spur, helical and herringbone gearing up to 180 inches in diameter, 20 inches in face, and 3/4DP.

Learn more about this new method for increasing the service life of your gear drives. Write for your copy of Bulletin 100.

phillie gear® / **PHILADELPHIA GEAR CORPORATION**
King of Prussia (Suburban Philadelphia), Pennsylvania

Leprechaun *(Continued)*

in research for Basic Magnesium at Henderson, Nev. during World War II, returned to the Great Basin area after arriving back in this country from Cuba in 1952. After a successful halite development in Detrital Wash., Ariz. which he and his associates, Robert Zuber and Roger L. du Charme, sold, the group began development in the Silver Peak area.

The group, with additional associates, acquired necessary permits in the area, and in the late summer of 1960 began physical exploration resulting in the successful discovery of a major lithia field by Leprechaun Mining and Chemical, Inc.

Mr. Zuber is field superintendent, Du Charme is vice president-secretary, Gerhardt Pralle, a graduate of Melbourne University with an advanced degree from Leoben Mining Academy in Austria, is the chief engineer for exploration.

Direct responsibility for the control of field work at Clayton Valley was with Mr. Zuber and Mr. Pralle. Dr. Donald Garrett, formerly Assistant Director of Research for American Potash and Chemical, Inc., is a consultant on process and market investigation.

Schwab Cites Destructive Effect of U.S. Policies

BUNKER HILL CO. president Charles E. Schwab told a meeting of business men at Coeur d'Alene, Idaho, that tariff policies in recent years have set a pattern for segments of American industry and labor to be slowly driven out of business by low cost imports. Schwab charged in an April 21 talk that when Congress passed the Trade Agreements Act of 1934 it abrogated its constitutional powers and handed over to the executive branch the power to regulate foreign trade. This law, he said, gave to the President the power to conclude trade agreements with other nations and the power to reduce tariff rates. He added that this principle was enlarged in 1948 with the General Agreement of Tariffs and Trade (GATT). He cited a slight reversal of the trend with changes in the Trade Agreements Act in 1951 and 1958 which provided an "escape clause" and which gave Congress the power to override the President's decision. He said the domestic lead-zinc industry, with its depressed prices, was an example of industry not being protected by present tariff policies. Predicting that the industry's "battle" in Washington, D.C., would continue, Schwab said, "It is too early in the present Congress and Administration to make any flat prediction for the outcome.

"Efforts on the part of domestic producers continue in the Congress and in the executive department but this is a 'long, tough road.' While we are hopeful that some action will be taken, we must nonetheless plan our operations as if the present very distressed prices will continue."

NEEDS NO RESHARPENING

Western Rock Bit design precludes the reverse taper dullness common to conventional bits and gives an effective drilling life, lasting far beyond the point where conventional bits must be withdrawn from service for resharpening.

Western Rock Bit's exclusive design accomplishes great drilling economies

fast drilling-long life
low first cost-low cost per foot of hole drilled

FORGED FOR TOUGHNESS FROM NICKEL ALLOY STEEL

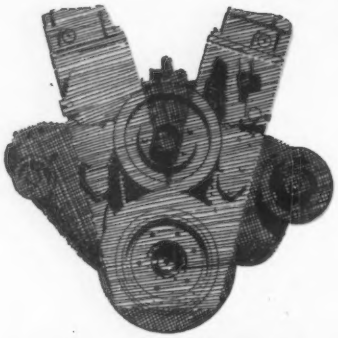
An exclusive process extrudes the steel under pressure in a manner that preserves the important grain of the steel and imparts unusual strength to the bit body.

Strong Superior Connection

tapered socket — no threads

WESTERN ROCK BIT
Manufacturing Company
552 West 7th South . Salt Lake City 1, Utah

BIG POWER FOR BIG JOBS!



CUMMINS V DIESELS DELIVER THE HIGHEST HORSEPOWER IN THE INDUSTRY!

Cummins big bore diesels—from 350 to 700 hp—finish off the big jobs fast! These V engines are in a class by themselves. They are the only diesels delivering up to 700 hp in mobile equipment.

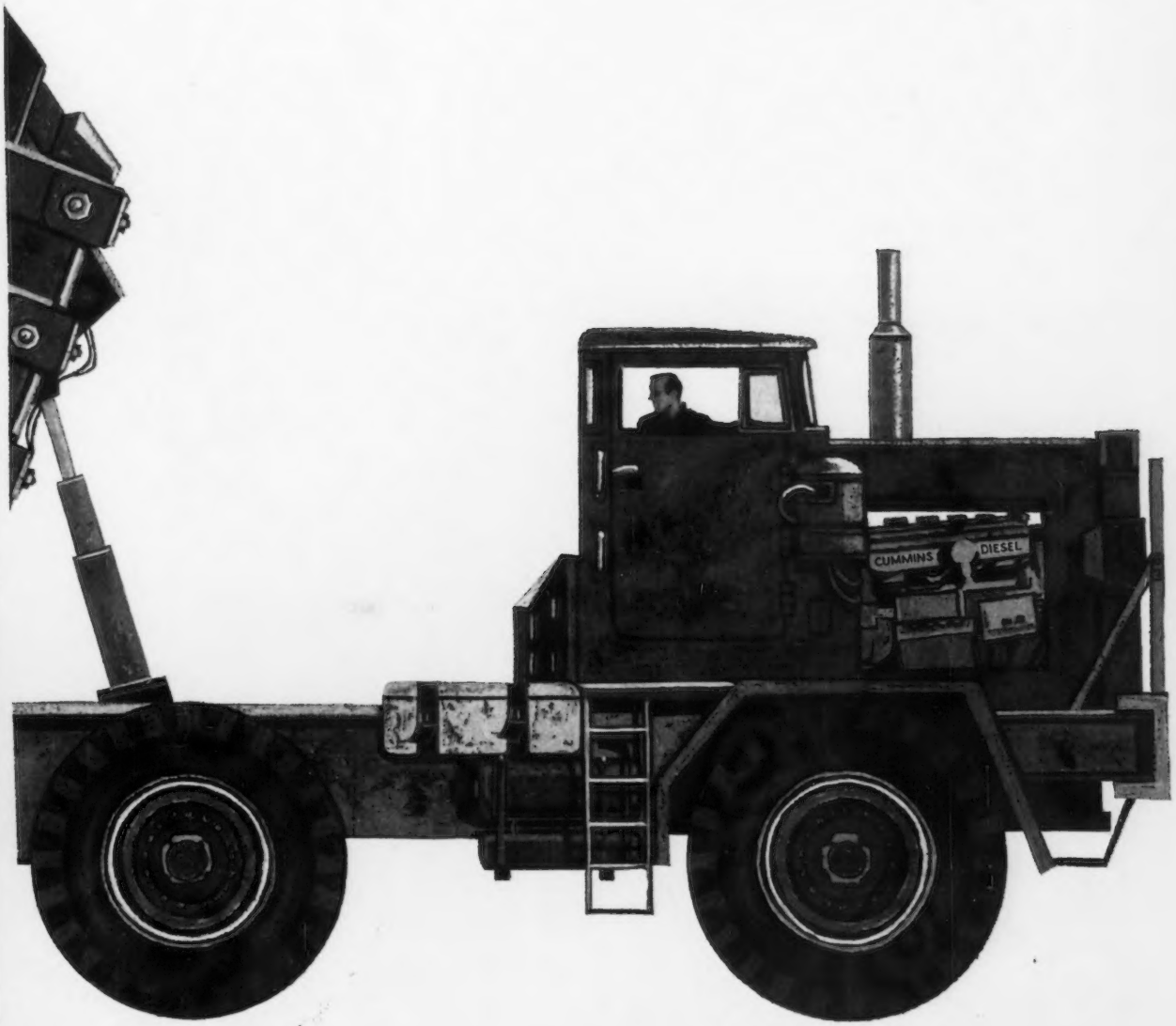
The more than one million V-12 horsepower in operation today prove that for the big jobs...Cummins Diesels are the standard of the industry. Now with the addition of Cummins two new V8 construction diesels, you have a full range of Cummins V power designed exclusively for off-highway use.

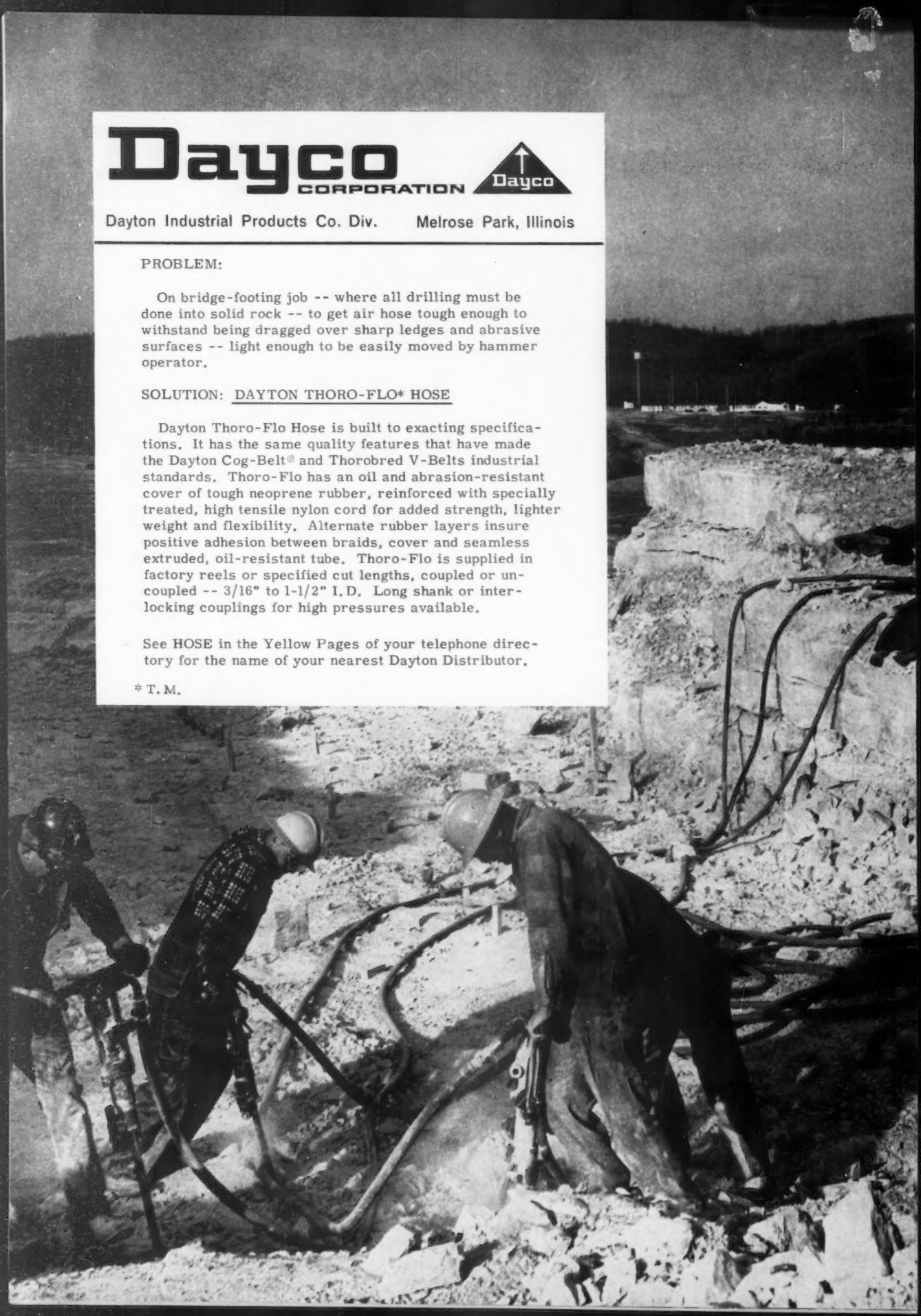
Make the wise investment—specify Cummins V Diesels for your equipment. Buy the most productive, highest horsepower available. Get the extra measure of Cummins dependability—the time-tested, work proven Cummins design and features that add extra years of on-the-job performance. Contact your equipment dealer or Cummins Distributor for the specific details on these big power diesels.

Cummins Engine Company, Inc., Columbus, Indiana

350 HP
430 HP
450 HP
525 HP
600 HP
700 HP

CUMMINS


CUMMINS
DIESEL



Dayco CORPORATION

Dayton Industrial Products Co. Div. Melrose Park, Illinois

PROBLEM:

On bridge-footing job -- where all drilling must be done into solid rock -- to get air hose tough enough to withstand being dragged over sharp ledges and abrasive surfaces -- light enough to be easily moved by hammer operator.

SOLUTION: DAYTON THORO-FLO* HOSE

Dayton Thoro-Flo Hose is built to exacting specifications. It has the same quality features that have made the Dayton Cog-Belt® and Thorobred V-Belts industrial standards. Thoro-Flo has an oil and abrasion-resistant cover of tough neoprene rubber, reinforced with specially treated, high tensile nylon cord for added strength, lighter weight and flexibility. Alternate rubber layers insure positive adhesion between braids, cover and seamless extruded, oil-resistant tube. Thoro-Flo is supplied in factory reels or specified cut lengths, coupled or uncoupled -- 3/16" to 1-1/2" I.D. Long shank or interlocking couplings for high pressures available.

See HOSE in the Yellow Pages of your telephone directory for the name of your nearest Dayton Distributor.

* T.M.

American Zinc, Tri-State Join $6-million Venture

TWO U. S. MINING COMPANIES agreed early last month to a $6-million joint venture involving some 20-million tons of zinc-bearing ores near New Market, Tenn. The firms: Tri-State Zinc, wholly-owned subsidiary of Consolidated Gold Fields of South Africa, and American Zinc Co. of Tennessee, subsidiary of American Zinc, Lead and Smelting of St. Louis, Mo.

Tri-State, by agreeing to mine and mill the ore deposits owned by American Zinc, now confirms an early 1960 understanding which committed the company to extend a drilling program carried out by American Zinc between 1954 and 1957. With successful completion of the drilling, Tri-State will develop the mine and erect a treatment plant, scheduled for 2800 tpd by the summer of 1962 and an eventual capacity of 3600 tpd. The mill will also process ore from other nearby mines of American Zinc until the new mineral body is fully developed.

Total cost of the project—including capital value of the deposits and American Zinc rights—is set at $6-million; after repayment of the initial investment. both companies will split the profits equally.

Tri-State will manage the joint venture, and, with the agreement, production from the area should get underway much earlier than previously expected.

Chile Announces Large Development Program

THE WORLDWIDE economic crash of 1929, which cut Chilean exports by 70%, prompted the government to undertake a diversification program to broaden industrial output. Studies were assigned to the Chilean Economic Development Corporation, (Corporacion de Fomento de

JOSE ZABALA, Corfo Director

INHERENT SPEED, PRECISION AND RUGGEDNESS distinguish the WILD T-1A for land, route, highway and mine surveys . . . day or underground. Automatic vertical collimation, readings direct to 20 seconds, estimations to 5 seconds, repeating with separate upper and lower motions, and built-in optical plummet make this instrument the preferred standard throughout the world.

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WILD T-1A OPTICAL REPEATING TRANSIT
One of a *complete* line of superb instruments for Surveying, Photogrammetry and Microscopy. *Write for BookletT-1A.*

WILD HEERBRUGG INSTRUMENTS, INC. • PORT WASHINGTON, NEW YORK
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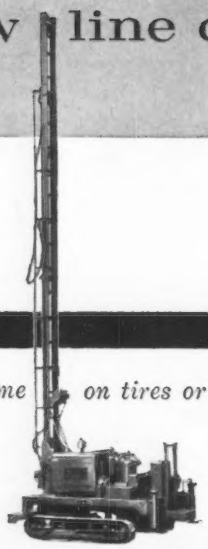
ANNOUNCING LE ROI'S

A new line of powerful . . . highly portable . . .



These rigs come on tires or tracks!

THE LRD-2

Here's a highly portable blasthole drill for making hole up to 4½ inches as deep as 30 feet . . . equipped for either positive-drive rotary drilling or powerful down-the-hole percussive drilling.

What's more, the LRD-2 is completely self-contained . . . and economically priced, too!

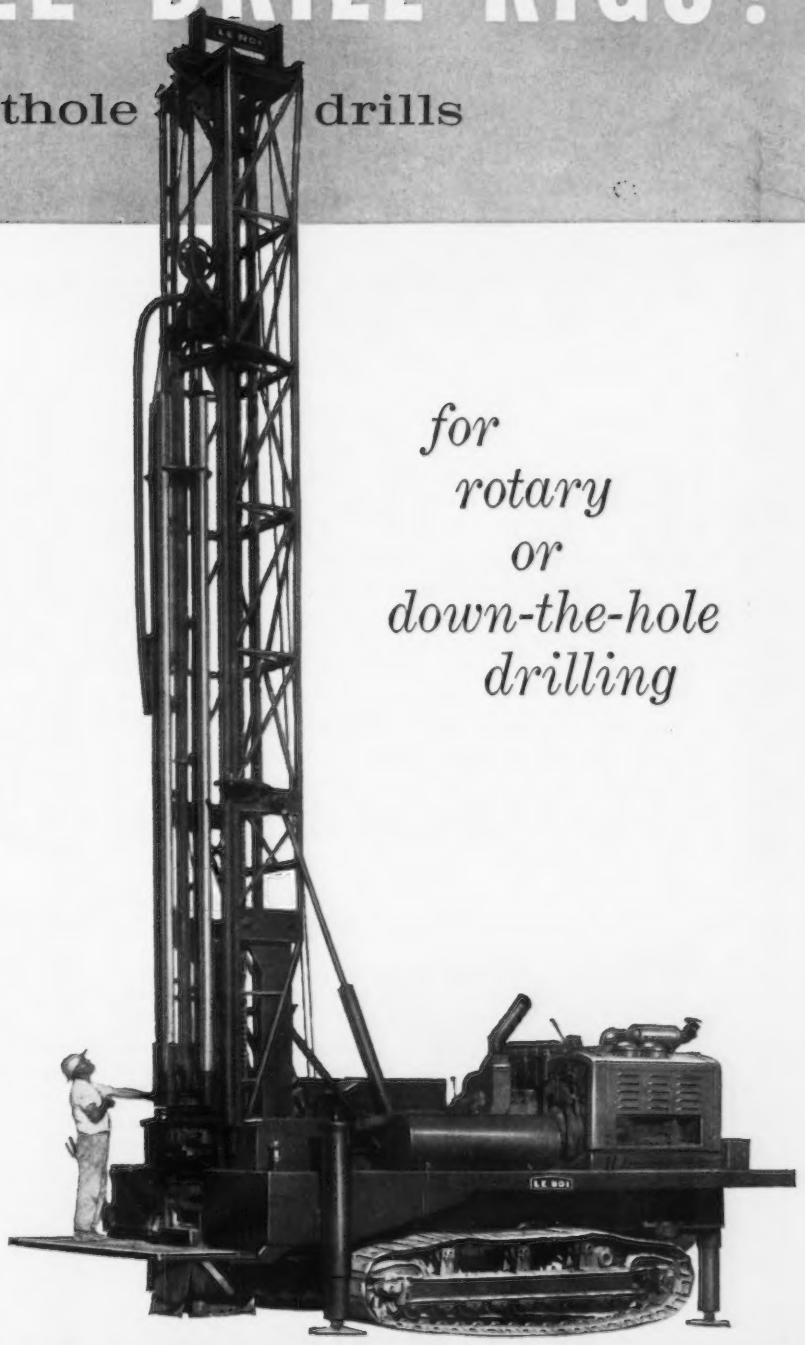
The entire unit is easily handled by one man. Controls are conveniently grouped at an operator's station located alongside the drilling area. The unit can be moved, leveling jacks hydraulically set, boom hydraulically raised, drill pipe and bits connected, and hole started — all with a few non-fatiguing motions.

Powerful direct mechanical drive keeps the rotary table turning — won't bog down or lose torque under rough going like air or hydraulic driven units — eats through tough rock formations under 10,000 lbs. pulldown pressure at speeds from 40 to 250 rpm. If necessary, a hard-hitting down-the-hole drill can quickly be substituted for the rotary bit to drill extremely hard rock formations. A Le Roi 25 hp two-stage air compressor provides ample air for powering the down-the-hole drill and cleaning out hole . . . or is available in single-stage where only rotary drilling is necessary.

The self-propelled LRD-2 is available either on crawler or tire mounting and with either gasoline or diesel power unit. A whole list of extra equipment is available to ease or speed drilling, including lights for night-time operation, a mounted bit grinder, air hoist, breakout tongs, water injection system, etc. . . . all detailed in Specification Sheet AT-146. Write for your copy.

DEEPHOLE DRILL RIGS!

rotary blasthole drills



for rotary or down-the-hole drilling

THE LRD-3

Here's the *big* rig . . . completely self-contained for putting down hole as large as 7⅞ in. to 100 ft. depth!

The LRD-3 is available with either crawler or truck mounting. An enclosed cab can be furnished to provide all-weather protection for the operator while drilling. All controls are conveniently grouped for easy operation and good visibility.

The traveling head design of the LRD-3 provides positive mechanical power without excessive torque loss under heavy pulldown, and permits easy control in making up and breaking down drill-rod. Every function of the unit is designed to speed productive drilling and keep the operator making hole. Leveling, raising the mast, and even the automatic drill pipe magazine are hydraulically controlled for speedy operation. A powerful dust collector traps cuttings and blows them well away from the unit.

An extra-sturdy 4-speed chain-hydraulic pulldown puts up to 30,000 lbs. of pressure on the bit of the LRD-3. A rugged dual-range transmission provides rotary speeds from 9 to 168 rpm in a selection of 10 forward and 2 reverse speeds.

Where needed, the rotary bit can be quickly changed for a powerful down-the-hole drill. A Le Roi 100 hp dual-manifold air compressor provides plenty of 100 psi air for punching through tough rock with the down-the-hole drill, or it can be set to deliver 625 cfm of 40 psi air for fast, efficient removal of cuttings in rotary operation.

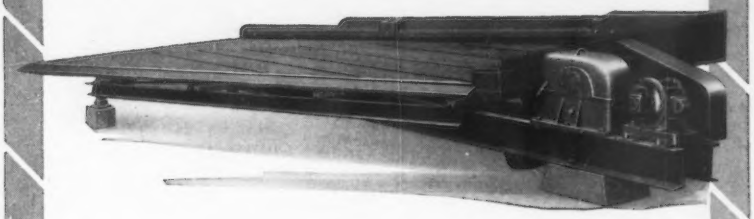
The LRD-3 comes complete with a hydraulically operated magazine with capacity for four 20 ft. drill pipes, and can be equipped with optional convenience equipment similar to the LRD-2. Specification Sheet AT-147 describes the unit in detail, with complete spec information. Send for a copy.

LE ROI

division of Westinghouse Air Brake Co.

Sidney, Ohio

High Grade Mineral Concentrates . . . . and more, with the SuperDuty® Table.



The sharpness of the concentrate bands on the SuperDuty table makes accurate cutting easy. You stand at the product end and see for yourself how accurately the values are separated, how the middlings for recirculation are reduced in volume. Then you can well be astonished at the minimized percentage of values lost in tailings

At the same time you learn that operating and maintenance costs are held to a bare minimum. Truly, you will not find anywhere a more efficient way to recover your mineral values. For more information, send for Bulletin 118-C.

CONCENCO® Type "CPC" Classifier

This all steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separations made by each main cell. Advantages offered are: (1) accurate classification or sharp sizing, (2) easy and effective hydraulic water regulation, (3) as many spigot products as there are cells, (4) continuous discharge, (5) no moving parts, (6) low maintenance cost.

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CONCENTRATOR
COMPANY
903 Glasgow Ave. • Fort Wayne, Ind., U.S.A.
CONCENCO PRODUCTS

★ *The ORIGINAL Deister Company* ★ *Inc. 1906*

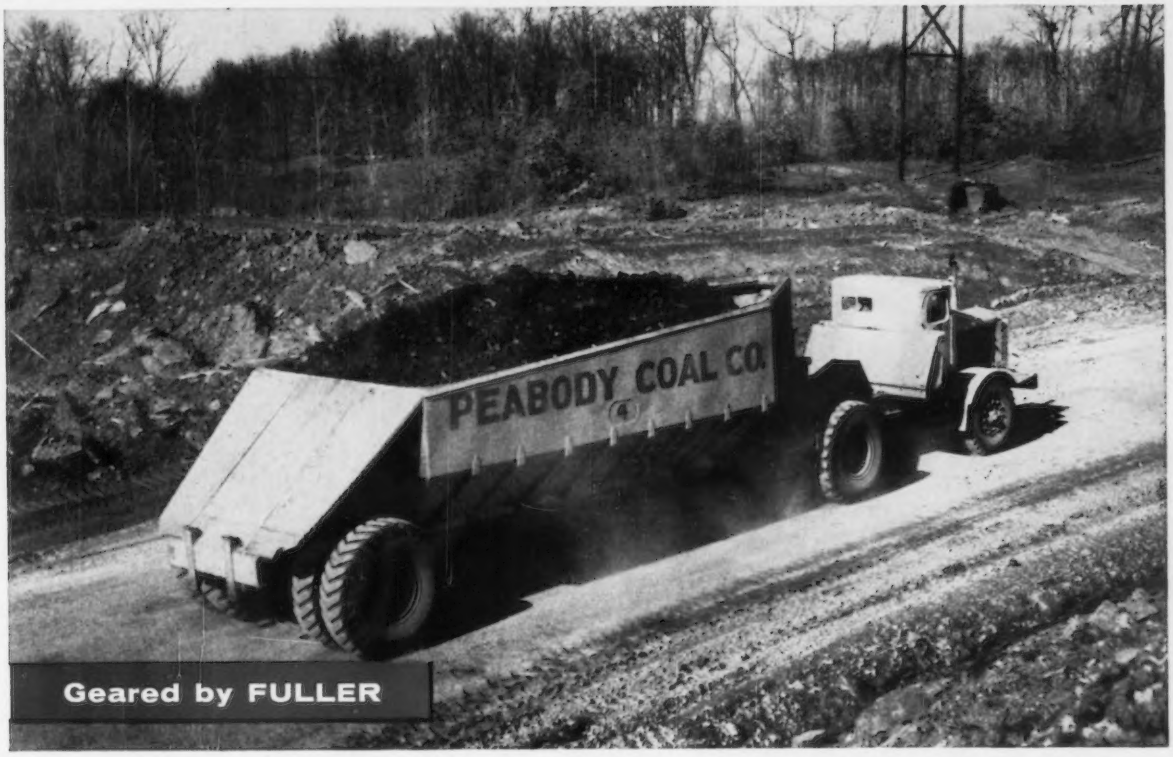
Corto *(Continued)*

WALTER MULLER, Ambassador to U.S. from the government of Chile.

la Produccion de Chile), now known as Corfo. Walter Muller, ambassador of Chile to the U.S. recently announced new plans of Corfo to stimulate Chile's economic growth at a rate of 5.5% per year during the current decade. A total of $10-billion will be required to finance the program between 1961 and 1970. Total net foreign investments during the 10 years should be about $316-million. The balance is expected to be raised internally by stimulating savings and private and government investment.

Jose Zabala, director of the New York office of the Chilean Development Corp., outlined some of the objectives of the 10-year program. On a percentage basis, the $10-billion investment will be allocated as follows: Building construction, 25.3; industry, 21.2; transportation, 14.5; power and fuel, 11.8; agriculture, 9.9; mining 7.2; contingency investment, 5.2; and urbanization and communication, 4.9.

Approximately $687-million in new mining investment is indicated over the ten-year period. This involves a production increase of 50,000 bbl per day of crude oil, 650-million lb of copper and 6-million tons of iron ore. The majority of new copper investment is expected to come from abroad. Ambassador Muller indicated that investments in copper production totalling some $400-million are being discussed by representatives of the Chilean Government and U.S. mining companies. Because of the magnitude of these investments, the U.S. firms are seeking special tax concessions, and conversations are proceeding along these lines. When asked by the press why Chile didn't give more attractive tax concessions to industry in general, Ambassador Muller pointed out that any tax favors granted to U.S. companies merely gave the U.S. Government a broader base on which to tax its nationals, and therefore any tax relief by Chile would be nullified except perhaps if the U.S. Government would parallel Chile in offering tax concessions to investors.



Peabody Coal Company of St. Louis, Missouri hauls 52-ton loads from their River King Mine in Illinois with *Fuller-equipped* Model 129TDT Euclid Tractors. These ten Euclid Tractors pull Model 124 Wagons with 61 cubic yard capacities. Engines in the Peabody Euclids are Cummins 350 hp V8 and NRTO 330 hp diesels and 12V71 336 hp Detroit Diesels. All drive through Fuller R-1160 ROADRANGER Transmissions and 14.96:1 axles.

Designed for Coal Hauling Equipment

Model R-1160 ROADRANGER Transmissions

Faster, smoother operation, greater fuel economy, faster cycles, and longer gear and bearing life are offered by the Fuller R-1160 ROADRANGER Transmission.

Check these advantages:

- No gear splitting—nine selective ratios evenly and progressively spaced (average of 38% steps).
- Easier, smoother shifting—one shift lever controls all nine forward and two reverse speeds.
- Pre-selected range shifts — automatic and synchronized, with range selector located on the shift lever.
- Quicker up shifts for constant operation in peak horsepower range — assured by Fuller air powered countershaft inertia brake.
- Prolonged gear and bearing life—Pressure Lubrication and Filtration System provides positive lubrication and maintains clean lubricating oil to prolong gear life.

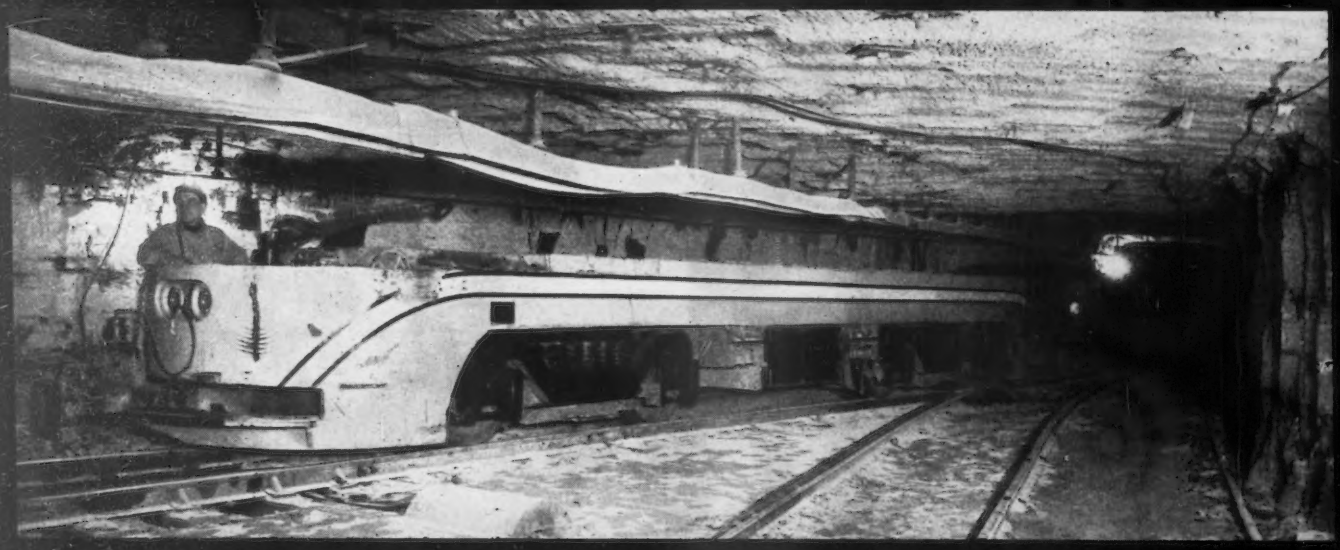
Gear	Ratio	% Step	
9th	.75	33	
8th	1.00	39	HIGH RANGE
7th	1.39	40	Reverse 3.31
6th	1.94	34	
5th	2.59		
RANGE SHIFT			
4th	3.48	39	
3rd	4.84	40	LOW RANGE
2nd	6.76	34	Reverse 11.53
1st	9.07		

Weight: 1133 lbs. Length: 44 21/32"
Clutch Housing Size: SAE No. 1
Oil Capacity: 35 pts.; w/filter 38 pts.
Approximate Engine Size: 1160 cu. in.

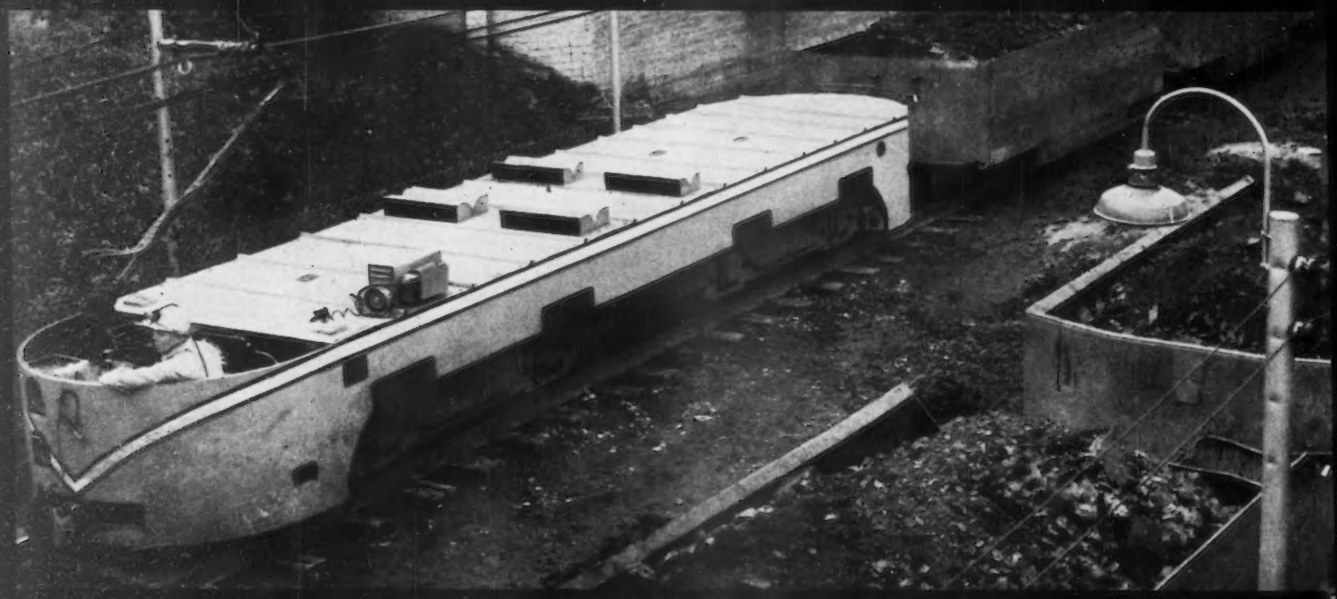
FULLER TRANSMISSION DIVISION
EATON MANUFACTURING COMPANY
KALAMAZOO, MICHIGAN

Sales & Service: West. Dist. Branch, Oakland 6, Cal. • Southwest Dist. Office, Tulsa 3, Okla. • Automotive Products Co., Ltd., Brock House, Langham St., London W.1, England, European Rep.

GENERAL ELECTRIC'S MINE LOCOMOTIVES



COMBINE ADDITIONAL SPEED AND POWER



TO INCREASE OUTPUT AND REDUCE COSTS

Below ground and above, General Electric 4-axle, swivel-truck mine locomotives build profits by hauling heavy loads at increased speeds.

The combined improvements in power, weight and speed reduce traffic congestion, simplify dispatching and boost tonnage per shift, thus reducing operating costs. Resulting performance matches the pace set by new highly productive face equipment.

Maintenance costs are lowered through latest design advances including high-rated motors, reliable control, rugged mechanical equipment and easy accessibility to all components. Even track maintenance is reduced by the smooth-riding short wheel base swivel trucks.

For more information on how to increase output and reduce costs with modern motive power, call the nearest General Electric Sales Office or write General Electric Company, Erie, Pennsylvania.

116-01

Progress Is Our Most Important Product

GENERAL ELECTRIC

Florida Mineral Firm Calms Householders' Fears

MINERAL RIGHTS to some 450 miles of Florida's West Coast shoreline are now the sole property of Coastal Petroleum Co., a wholly-owned subsidiary of Coastal Caribbean Oils, according to a decision handed down by the Florida Supreme Court. With legal say-so on its side, Coastal has stirred West Coast land developers by insisting that certain dredging and filling operations along 4.5 million acres of tideland—including 660,000 acres of inland lakes and rivers, one of which is Lake Okeechobee—constitute infringement of leasehold interests. And Coastal says further that Florida's potential natural resources are in jeopardy unless its judicial rights are defended.

Coastal's leases for oil, gas and mineral production, reaching from Apalchiola in the north to below Naples in the south and from the shore to 10.3 miles into the Gulf of Mexico, were awarded by the trustees of the Internal Development Improvement in 1944. Ten years later the Trustees sought to amend the original contracts to exclude Coastal's mineral rights, but the company fought this decision, and last November, Coastal won its case in the state Supreme Court.

Now, Florida officials are seriously concerned that Coastal may exercise its rights in full and attempt to claim minerals from people now living on filled land within the leased area. Hundreds of thousands of developed acres are involved. Coastal has already sent out letters to developers and diggers advising them that they "may not know they are operating" inside Coastal's lease boundaries and "suggesting representatives get together and talk the matter over." But Benjamin W. Heath, company president, maintains that Coastal will not bother either "innocent owners, purchasers or developers," or impede certain land reclamation.

The object of the controversy: Florida's mineral production which reached nearly $170-million in 1960 and is expected to continue increasing. State output of phosphate, zircon and Fuller's earth is first in the nation, while Florida places second with the titanium minerals, monazite and peat. Coastal expects to place special emphasis on the heavy minerals, now earmarked for jet aircraft and missile components.

Odlum Predicts U_3O_8 Shortages in 1966

ACCORDING to Floyd B. Odlum, retired financier, a shortage of uranium reserves in the U.S. will occur between "about 1965 and 1967."

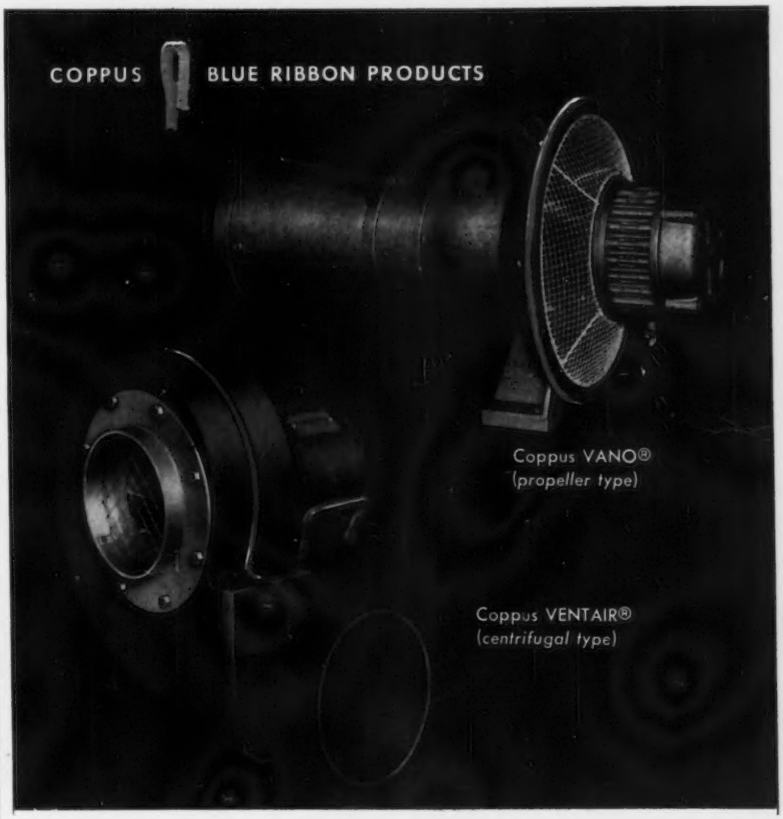
Mr. Odlum, former chairman of Atlas Corp. and of Hidden Splendor Mining Co., said at Salt Lake City that the U.S. is "grinding up its uranium reserves at the rate of about 10% a year" and is "not finding any new ore."

Mr. Odlum, whose activities were on a major scale during the U.S. uranium boom of the 1950's, looks toward another such "uranium rush."

He based his predictions on view that "nuclear weapons of all sorts and varieties will continue to be with us for some time." And on the fact that world needs for nuclear energy, including those of the United States, will develop and grow in expansion of central power generation of electricity. He warned that the United States had lost its lead in oil reserves and production to other nations of the world and was now behind Canada and Africa in uranium reserves.

Kennecott Forms Group For Solid State Study

KENNECOTT COPPER is planning to establish an organization for basic research, in addition to its applied research program, with primary interest in solid state physics of metals. To head the new unit, Kennecott has chosen Dr. Ewan Fletcher from the Massachusetts Institute of Technology where he had been supervisor of the research group, Department of Electrical Engineering, and a consultant to such firms as Eastman Kodak, Minneap-



GET 30% TO 100% MORE AIR

Coppus Blowers for mine ventilation include the centrifugal VENTAIR for long pipe lines and the propeller-type VANO for shorter lines. For a given power consumption both deliver from 30% to 100% more air than an ordinary fan.

Serving as blowers or exhausters they are driven either by electric motor or compressed air, with capacities up to 60,000 CFM. Like all Coppus Products, these blowers carry the same "Blue Ribbon" assurance of quality and dependable performance.

Representatives located in all mining areas. Other Coppus "Blue Ribbon" products: Steam turbines, gas burners, heat killers, air filters, blowers and exhausters for special purposes. See also *Thomas' Register*. Coppus Engineering Corporation, Worcester 10, Mass.

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Users repeatedly specify

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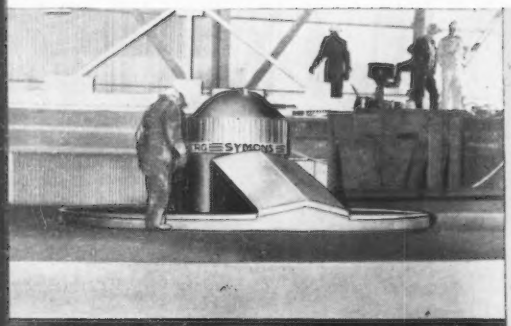
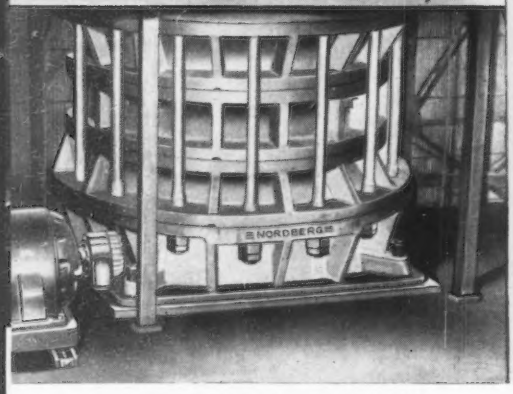
for reliable, low cost production of ORES and MINERALS





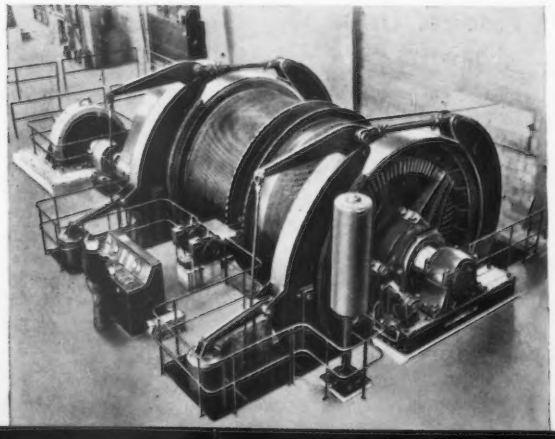
FOR PRIMARY CRUSHING OF MOLYBDENUM

This 60″ Symons Primary Gyratory Crusher has seen several years of service in the primary breaking of "moly" ores in Colorado. Other heavy duty Symons Gyratory Crushers are built with 30″, 42″, 48″, 54″ and 72″ feed opening widths and for capacities to 3500 or more tons per hour.

Your interest in lowering the cost, improving the quality, and raising the production of metallic and non-metallic ores and industrial minerals is a mutual interest which Nordberg has shared with the mining industry for 75 years.

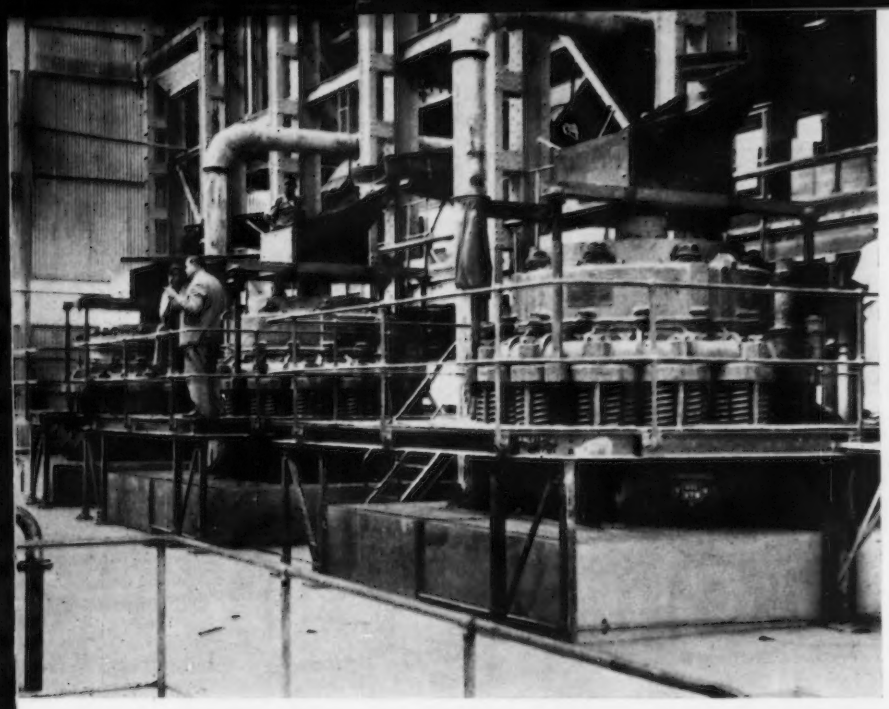
This common interest and the many years of broad, yet intimate experience with the mining fraternity is reflected in the effectiveness and quality of Nordberg mining machinery. It is because of this background that Nordberg continues to lead in the design and construction of mining machinery which is *consistently first choice of the world's leading ore and mineral producers.*

SYMONS . . . a registered Nordberg trademark known throughout the world.



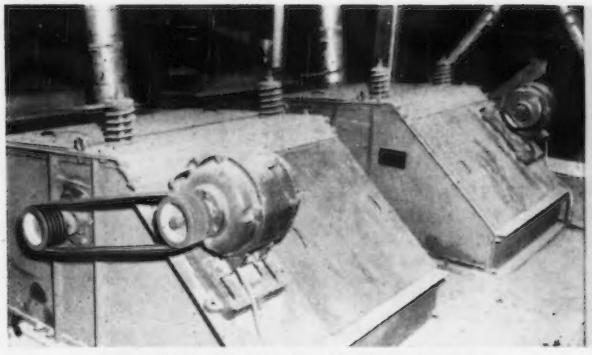
FOR HOISTING IRON ORE

Nordberg Mine Hoists for men and material are built in both conventional drum types as well as friction types . . . for push-button semi-automatic, fully automatic or manual control. Shown is a typical conventional double drum hoist.



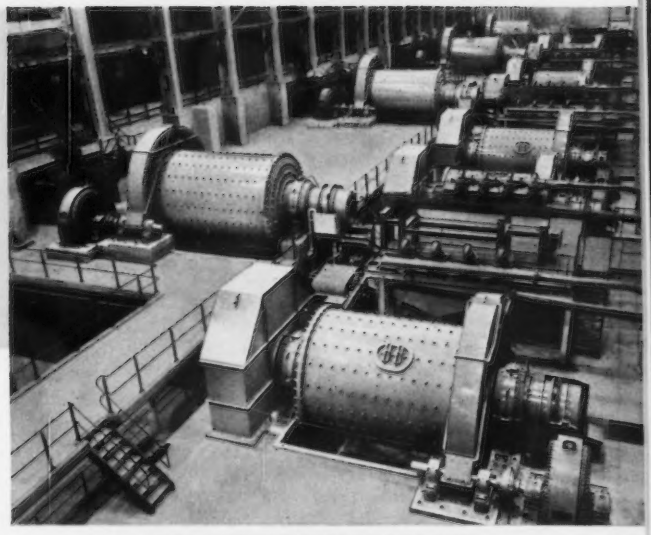
FOR FINE REDUCTION CRUSHING OF COPPER

These three Symons Cone Crushers are serving a Northern Rhodesian copper mine installation. Used for low cost, continuous production of quality products, Symons Cones are first choice of major producers the world over, in capacities to over 1500 tons per hour.



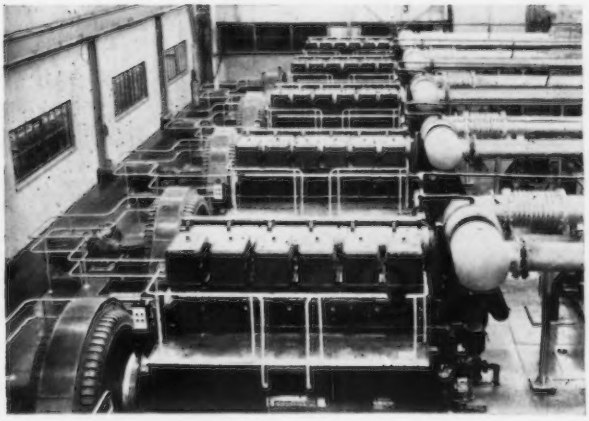
FOR SCREENING URANIUM ORE

These two 4′ x 8′ Symons Rod Deck Screens serve a large uranium processing operation in Canada. Other Symons Vibrating Screens are built in a wide range of types and sizes to handle numerous ore and mineral separation jobs from scalping to fine screening.



FOR GRINDING TACONITE

Shown are but a few of the many Nordberg Grinding Mills being used to reduce hard, abrasive taconite iron ore to the fineness of flour. Nordberg mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes to 13′ in diameter and up to 50′ in length.



FOR POWER GENERATION

Nordberg 2-cycle and 4-cycle diesel, Duafuel®, and spark-ignition gas engines are reliably serving the mining industry in many parts of the world. Sizes range from 10 to over 12,000 hp in a single engine.

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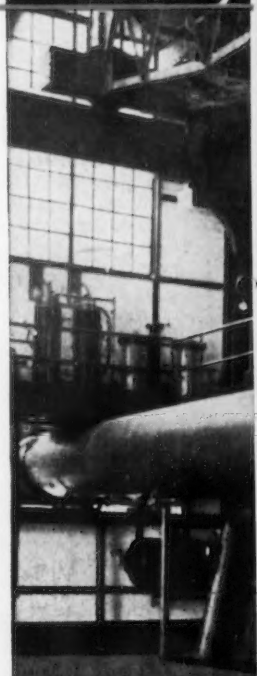
M161

from URANIUM in SASKATCHEWAN
to NITRATES in CHILE . . .

NORDBERG ENGINES
prove their reliability and economy
in MINING SERVICE

AT GUNNAR MINES, LIMITED . . . Neither bitter cold, nor inaccessible location could stop the successful development of a strategically valuable uranium ore deposit by Gunnar Mines, Limited, located in northwest Saskatchewan, less than 450 miles south of the Arctic Circle.

To meet the electrical power requirements for the construction and operation of mine, mill and town facilities, Gunnar chose seven Nordberg Supairthermal® 4-cycle diesel engine-generator units, each rated 1200 hp at 450 rpm, direct connected to 845 kw generators. Adding to the efficiency of this installation are waste heat boilers which utilize exhaust gas from the Nordberg engines to produce steam for heating plant buildings.



AT ANGLO-LAUTARO NITRATE CORPORATION . . . The story of power plant expansion for Anglo-Lautaro Nitrate Corporation's vast operations in northern Chile is largely a story of reliable Nordberg power. Their original Nordberg engine was a 7100 hp diesel unit installed in the Pedro de Valdivia plant, followed by the installation of two 1900 hp Nordberg diesels for the plant at María Elena. Then, to meet much needed additional power, two big 9600 hp Nordberg diesels were installed in a new power plant at Coya Sur.

Now Anglo-Lautaro has again turned to Nordberg to meet further power expansion, and has ordered *five more* Nordberg diesels, each rated 5750 hp, to be installed in the Pedro de Valdivia power plant. When these new engines are put in service, the combined generating capacity of all ten Nordberg engines will provide over 38,000 kilowatts for nitrate production.

While these installations in Saskatchewan and Chile are widely separated geographically, they serve as striking examples of the way in which Nordberg engines are serving the varied power requirements of the mining industry . . . especially in remote areas where dependable operation is of prime importance.

NORDBERG MACHINERY

NORDBERG MANUFACTURING COMPANY

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P959

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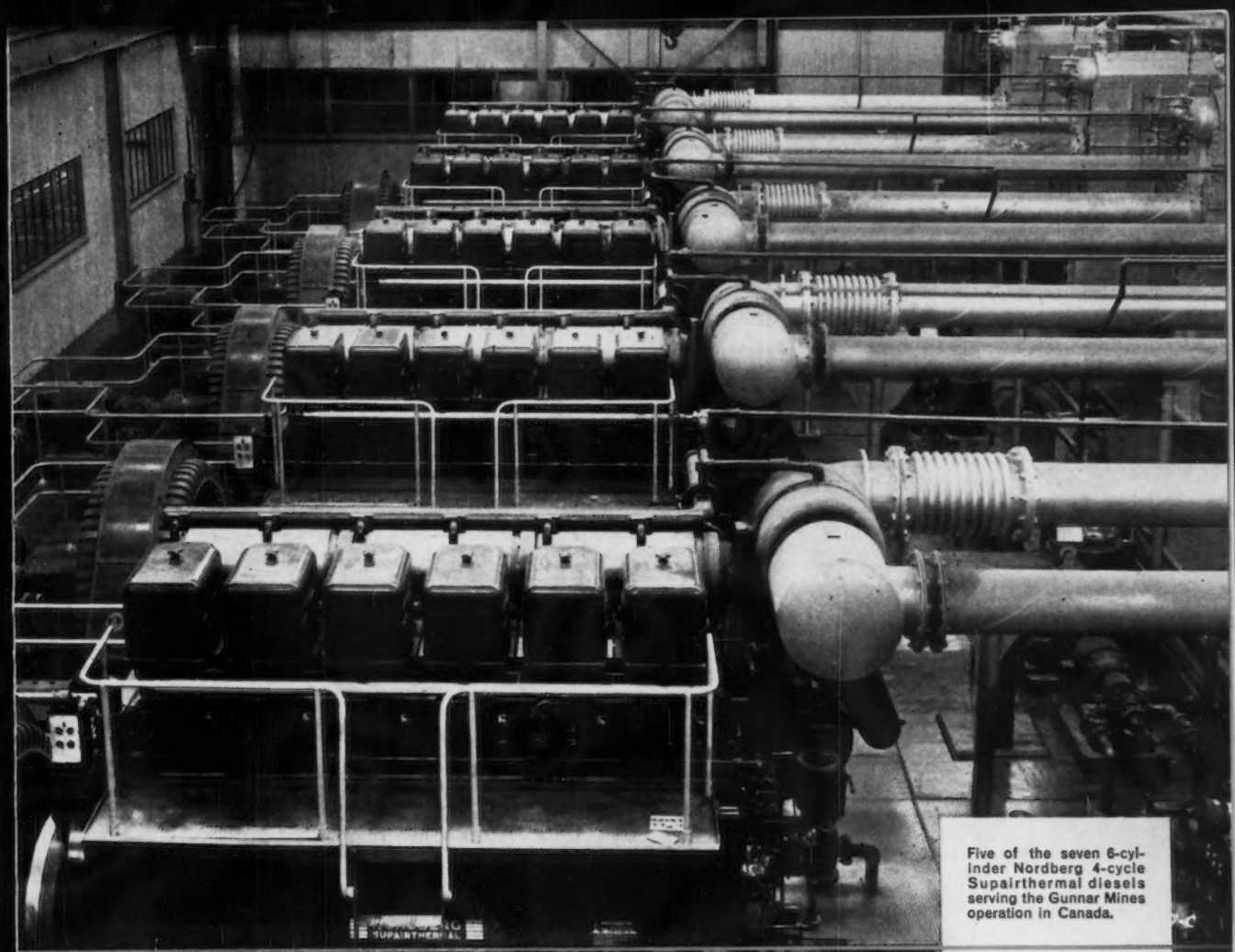
NORDBERG GRINDING MILLS

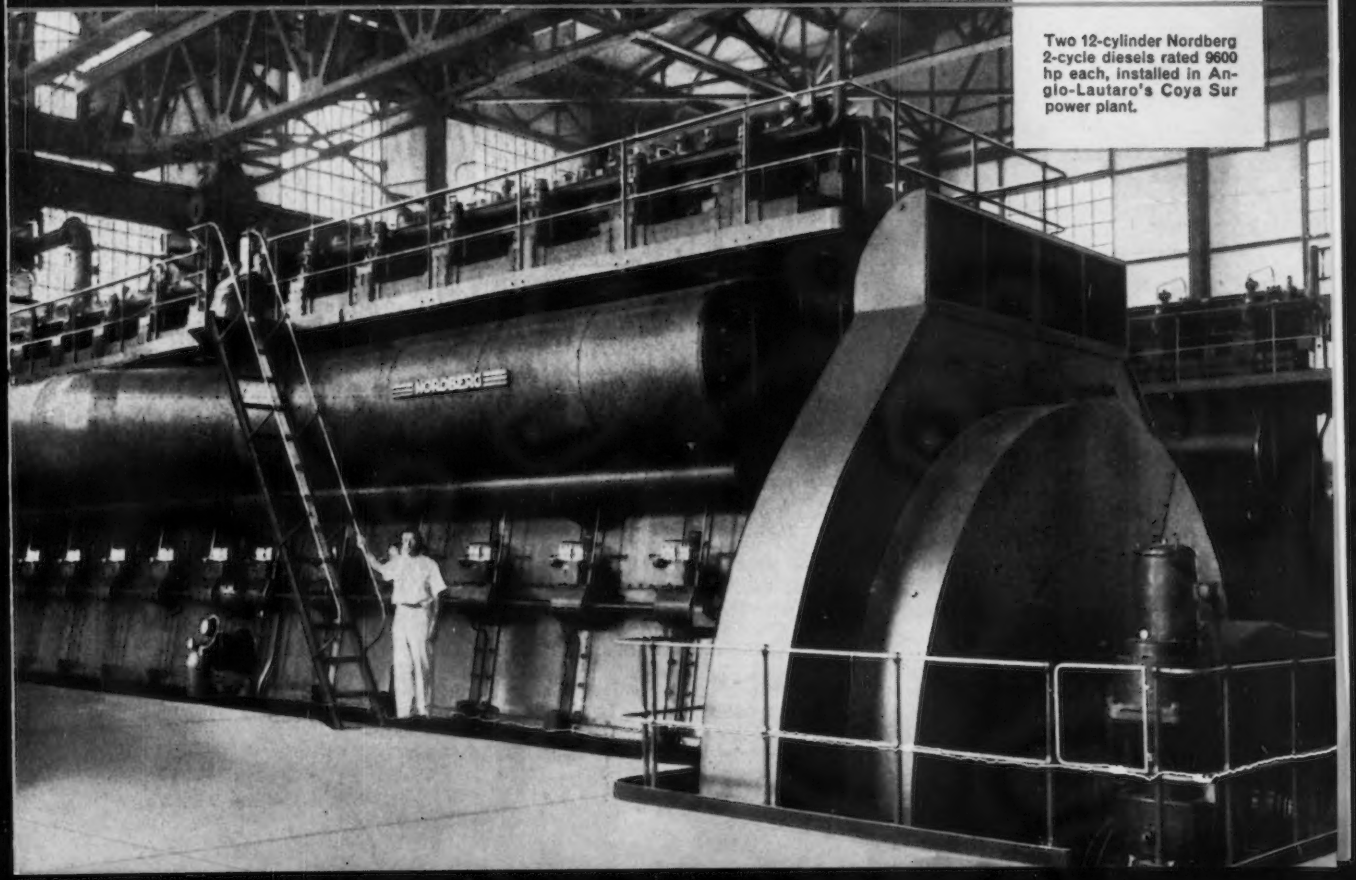
SYMONS VIBRATING SCREENS

SYMONS VIBRATING GRIZZLIES

NORDBERG MINE HOISTS



Five of the seven 6-cylinder Nordberg 4-cycle Supairthermal diesels serving the Gunnar Mines operation in Canada.



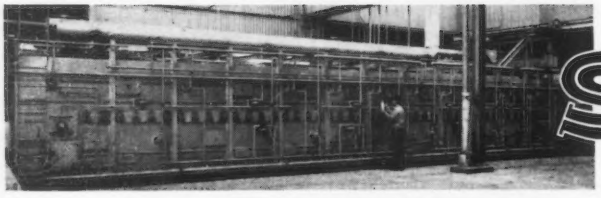
Two 12-cylinder Nordberg 2-cycle diesels rated 9600 hp each, installed in Anglo-Lautaro's Coya Sur power plant.

For iron, carbon and alloy steel castings

CAPITOL FOUNDRY DIVISION

has unmatched facilities

Quality



Service

Delivery

DESIGN WITH STEEL CASTINGS Centennial 1861-1961 STRENGTH IN SHAPE

Quality that's inherent in the use of all the latest foundry techniques *plus* experience that stretches back over the years. All melting is performed in electric furnaces.

Service that stems from the operation of a production foundry in Capitol's new and modern 208,000 square foot facilities.

Delivery schedules that are fast and flexible for standard castings as well as specialty items in such metals as gray iron, Ni-hard iron, carbon, chrome-moly, manganese, and Austenitic manganese steel. A-3106A

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NATIONAL MALLEABLE and STEEL **CASTINGS COMPANY**

General Offices • Cleveland 6, Ohio • International Division

Fletcher *(Continued)*

olis Honeywell, P. R. Mallory and the Columbia Broadcasting System. Fletcher has also worked extensively in communication engineering, electromechano device research, applied physics, microwave spectrography and vacuum tube techniques. In another appointment, Dr. Mervin J. Kelly, former director of Bell Telephone Laboratories, was named consultant to the research organization.

Lucky Boy Starts WO_3 Shipments to the Mill

TRANS-MOUNTAIN URANIUM CO. of Colo. Springs, Colo., has started moving tungsten ore shipments from its Lucky Boy mine, near Pikes Peak, to the mill on a regular basis. Using a leased truck, company drivers are bringing about seven truck-loads of ore per week to a mill at Florence, Colo., owned by the American Mining and Milling Co. To insure immediate treatment of the ore, Trans-Mountain has bought a 25% interest in the mill, which will be enlarged to 50 tpd.

However, mine production now stands at only one-third to one-half of potential, due, company officials say, to limited working capital. Approximately 100 tons of ore are stockpiled on the surface, and another 100 tons lie in Stope 1. Trans-Mountain estimates ore value at $120 per ton.

Mine crews are stoping as well as driving on both the east and west drifts. Plans are set to sink an additional 100 ft where all indications point towards better grade tungsten and commercial possibilities for gold, beryl, silver and copper ores.

Uranium-Alloy Steel Gains In Industry Applications

CANADA'S Dept. of Mines and Surveys has extended its development of the new steel alloy which contains small amounts of uranium to improve fatigue strength, stress corrosion resistance and elevated temperatures properties. Research by the Department's Physical Metallurgy Div. revealed that adding 0.01-1.0% of uranium to inexpensive plain carbon and low alloy steels yields a product that has improved limit-tensile strength—important for boilers, tubing, wire cable—and increased stress corrosion resistance, which can improve drilling equipment, gear hoist machinery and railroad axles.

The marine use of alloy steel can be expanded since the introduction of uranium also reduces pitting corrosion. Canada is applying for numerous overseas patent rights on uranium-alloy steel, which is now available to the Canadian steel industry.

U. of California Offers Mining Scholarships

THE MINING DEPARTMENT of the University of California at Berkeley has received a bequest from the estate of the late Martin J. Heller (Mining Engineering, U. of C.) to establish fellowships for graduate research in mining and mining engineering. The request totals some $1.5-million, and present receipts are sufficient to grant a few fellowships for the academic year 1961-62.

New Soundings Question Composition of Crust

RECENT SOUNDINGS of the uncharted regions of the earth's crust have indicated this area may be a complex structure and not a homogeneous granitic mass as generally believed, according to the preliminary data obtained by Dr. C. H. Dix, a CalTech geophysicist, using a new depth-sounding technique.

The sounding technique Dr. Dix employs is similar to that used by seismic prospectors in that it uses dynamite and highly sensitive geophones. Dr. Dix used the new technique in an area 15 miles south of Tulsa where he detonated 200 lb of dynamite in a series of 100-ft deep holes simultaneously. Blast shock penetrated the earth and reflected back to the geophones 20 miles away.

Jackpile Uses A Ripper for Final Cleanup

SELECTIVE MINING has proved the most effective, economical way of mining the scattered lenticular ore deposits (approximately 50,000 tons) at the Jackpile open pit uranium mine, N.M.

Due to the nature of the deposits, which remained after mining of the main ore deposit had been completed in many areas of the pit, shovel excavation without prior shattering of the material would be extremely slow, and blasting for shovel loading would be uneconomical since it involved dilution of the commercial grade ore with surrounding low grade and waste material.

A test, successfully performed in one of the more heavily consolidated overburden areas outside the pit, resulted in the purchase of a D9 Cat tractor with power shift transmission. The attachments include a ripper with two teeth and a 98 bulldozer with tilt cylinder to give added prying action in digging out ore chunks in consolidated portions.

The material is first ripped one way, the cross-ripped to break ore into easily-handled pieces for loading. It is then bulldozed into a pile, and loaded into hauling units with one of the several shovels in use. Hourly ripping and dozing production varies from 200 to 350 tph, depending on the nature of the deposit.

Just mix and pour

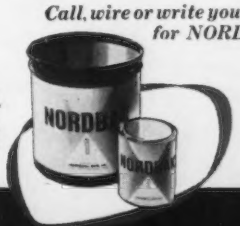
NORDBAK

Tough, Resilient, Non-Metallic

Here it is! NORDBAK . . . the manganese backing you pour at "room temperature." You simply mix the contents of two cans together and pour!

Field tests and on-the-job experience show that NORDBAK really works! Because it's resilient and non-shrinking, it provides excellent backing. It's so tough that in a prolonged test the manganese wore through in spots, but NORDBAK remained uncracked. It's easily removed at changeout, too. You can store NORDBAK at your operations . . . get a supply to keep on hand, ready for the next time you replace liners.

Call, wire or write your order for NORDBAK!



NORDBERG MACHINERY

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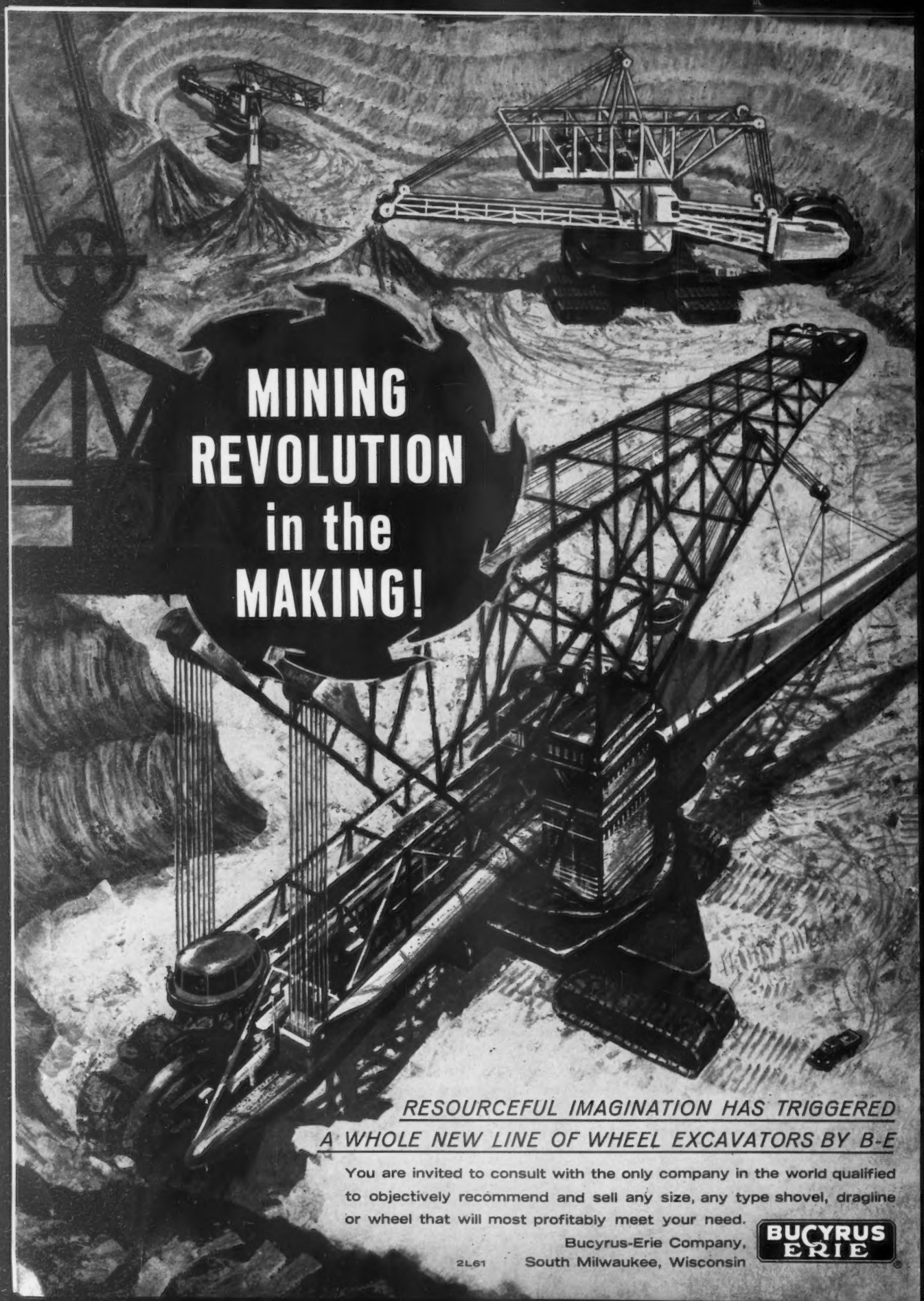
NORDBERG MFG. CO.

Milwaukee 1, Wisconsin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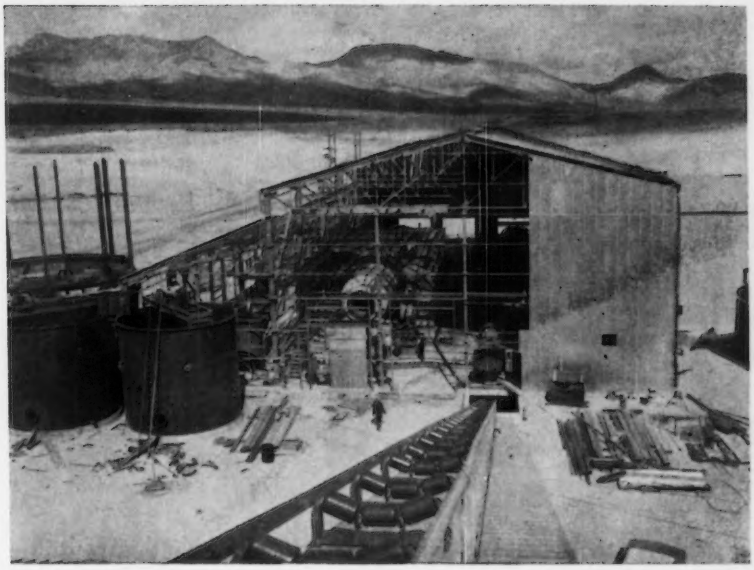

THE MODERN PLANT at the Anaconda property in Nevada is expected to permit production of a higher grade concentrate, based on a flowsheet by Bill Wraith.

Weed Heights' Plant Due in Fall

WORK on the new concentrator for the Anaconda Co. at Weed Heights, Nev., is progressing on schedule.

At this time about half the work has been completed. This includes coarse-ore storage, fine-ore storage, the concentrator proper, tailings thickener, pump house, and tailings dam.

Most of the steel structures have been erected and machinery and equipment is now being placed. It is expected that all work will have been completed and the concentrator ready to start by October.

The concentrator will consist of two sections, each being fed from a 10x14-ft ball mill. According to A. E. Millar, manager at Weed Heights, the flowsheet in the new concentrator is the design of Bill Wraith who is in charge of metallurgy for the Anaconda Co. Millar states that Wraith's flowsheet, as installed at other locations, has resulted in higher grade concentrate than has been customary in the past. Each section in the Weed Heights concentrator will handle 2500 short tons per day, so that the total capacity of the concentrator will be at least 5000 tpd.

$500,000 Was Expended in Maine Surveys

MINERAL EXPLORATION in Maine kept active in 1960, extending the probe for mineral potential which began in earnest in 1956. Last year, mining companies and both Federal and state agencies spent approximately $500,000 on surveys for nickel, copper mineralization, asbestos, diatomaceous earth, magnetic anomalies, slate, and pegmatitic columbite and beryl.

In Knox and Somerset Counties, the R. F. Beers Co. of Troy, N. Y., continued its two-pronged search for nickel. The Knox County program consisted of a second stage diamond drill program and further detailed geophysical work over the known deposit; milling tests on high and low grade ore material gave satisfactory results. South of Moosehead Lake, in Somerset County, Beers carried out geophysical and detailed geological surveying near a sulphide-bearing gabbro body. And in northern Somerset, Scott Paper continued diamond drilling for copper mineralization in a major shear zone.

More diamond drilling took place in northwestern Maine, where sheared greenstone rocks may hold asbestos deposits. The program was supplemented by geological survey, and an expanded program should be underway this year.

Meanwhile, several small operators who pushed surveys for workable diatomaceous earth deposits had some success: a large deposit was discovered and tested in detail near Bar Harbor. But while several hundred thousand tons of high grade limestone were added to Knox County's known reserves, last year's interest in increasing limestone reserves dropped from 1959.

At the Cape Rosier property in Hancock County, Penebscot Mining Co. renewed activity and plans to push a major drilling and geological mapping program. Penebscot represents a part of a recent upsurge of interest down the entire coastal metal producing belt.

And several other major mining companies began to look to Maine for new mineral production. Two indications are the influx of reconnaissance parties looking for more aerial information and the

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It had to happen . . . someone was bound to find a way to end the problems of backing manganese crusher parts with molten metal!

Now . . . you can do it with NORDBAK!

It's mixed at "room temperature" and poured right from a can into the crusher cavities. Gone is the need for special melting and pouring equipment . . . and gone are the hazards of pouring hot metal.

An initial, low cost order to back one set of crusher parts will prove the many advantages of NORDBAK *. . . call, write or wire your order today!*

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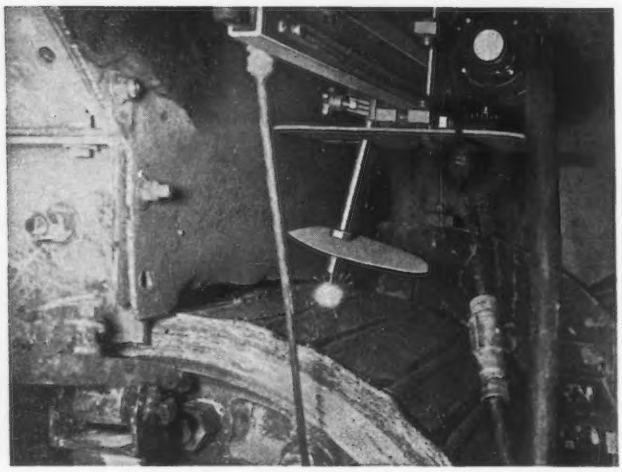
N261-1/3R2

NORDBERG MFG. CO.

Milwaukee 1, Wisconsin

Announcing 3 NEW STOODY Automatic Welding Systems!

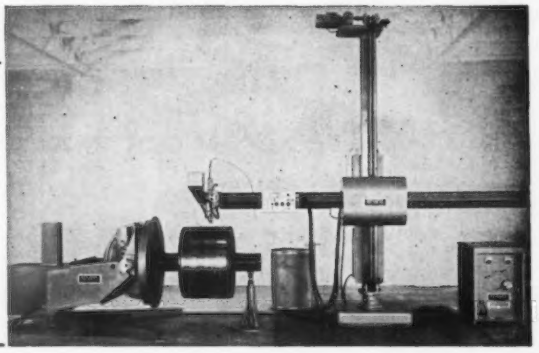


Stoody has long been the recognized leader in alloy wires for automatic hard-facing as well as for hard-facing rods and electrodes. No other manufacturer offers equal experience or a product line so versatile and complete.

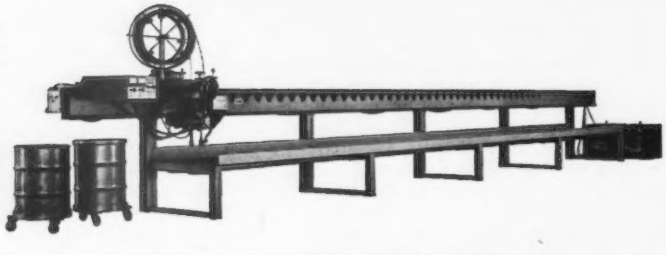
Now Stoody augments the best hard-facing materials available to industry *with a whole new line of automatic welding machines* covering specialized and general needs. Before investing in any automatic welding machines check with Stoody . . . pioneers and developers in the field of hard-facing, *manufacturers of the latest designs in AUTOMATIC WELDING SYSTEMS!*

1 **STOODY CRUSHERMATIC**—A compact, versatile system for automatically rebuilding and hard-facing crusher rolls in position. It enables the welder to work outside the crusher chassis in comfort and clean air. The Crushermatic consists of a motorized carriage riding a track which is suspended over the crusher roll. Wire is supplied to the carriage by any standard semi-automatic wire feeding unit. Uses a 400 amp power supply but 600 amps are preferable. Versatile electronic controls provide proper sequencing for a *variety of circumferential and transverse welding patterns.* The Crushermatic is portable by one man and is slipped into permanently welded brackets when in use. *It deposits up to 20 lbs. per hour—300% to 400% faster than manual welding and 200% faster than hand-held semi-automatic welding.*

2 **STOODY MODEL U W UNIVERSAL AUTOMATIC WELDER**—The Model U W provides a complete welding system capable of cylindrical, conical and straight line welding. The 3000 lb. capacity positioner *tilts the workpiece through a 120° angle and is equipped with power elevation and thyratron controlled rotation.* All electrical controls are unitized in a *portable control panel* for maximum operator convenience. *Ram type manipulator* has a vertical travel from 6" to 8'-6"; Horizontal travel: 10'; Travel speed range: 5 imp to approximately 60 ipm. Manipulator mast *rotates through 360°.* Power source: *DC, constant potential selenium rectifier type.* Input: 220-440 V, Output: 500 amps at 40 V 100% duty cycle. 5 point slope control.



3 **STOODY MODEL T L DUAL-HEAD TRACK LINK WELDER**—Provides dual welding heads with wires supplied from twin Payoffpaks for fast, efficient rebuilding and hard-facing. Extremely rugged construction. Features: *Special gear-type wire feed rolls; positive high frequency starters; wider, lower bed for easier accessibility and greater capacity; heavy-duty double worm reduction gear box with DC variable speed travel drive motor. Unitized control panel.* Bed length 40'; Bed width 46"; Bed height only 24"; Power: 2-500 amp constant voltage 100% duty cycle 220-440 V power sources.



• *For full information on all STOODY AUTOMATIC WELDING SYSTEMS see your Stoody dealer (check the Yellow Pages of your phone book) or write direct.*

STOODY COMPANY
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Maine *(Continued)*

STATE GEOLOGIST John Doyle is shown examining a diatomaceous earth sample from Noyes Pond, Blue Hill, Me.

just-completed lease arrangements of one firm with an important timberland owner for long term exploration. Some smaller survey programs in the Munson slate area and in Oxford County's beryl-columbite pegmitites, all leading to more work in 1961, rounded out the mining companies' activities.

The Maine Geological Survey completed a geological - geophysical - geochemical study of an eastern Penebscot County zone of airborne magnetic anomalies, with results to be published this spring. Besides this, the Maine Survey supported 12 field mapping parties throughout the state.

Federal agency activity — sponsored by the U.S. Geological Survey — centered around an extension of the Siluro-Devonian rock belt in northwestern Maine. A 1959 gravity study, made up of long, cross-structure traverses, continued throughout last year, should be completed in 1962. The USGS did finish its 3-year geochemical field research near the Moosehead Lake region, and the data is scheduled for future publication. One government contribution which may bolster exploratory activity was the release for open file distribution of geologic and aeromagnetic survey results in northwestern Maine. The State Survey has already distributed this material to interested mining companies. And finally the Bureau of Mines began a major study of pegmatitic beryl in western Maine, starting with equipment and technique testing as well as a preliminary survey. The Bureau plans a more active program this year.

All this activity points to increased exploration over last year. The search for nickel, asbestos and base metals particularly will intensify as mining companies more tightly define their target areas and competition for the choicer locations increases.

Material Procurement Sections Are Reorganized

THE AEC has reorganized the Source Material Procurement Div. and has reduced the number of division branches from four to three. The Concentrate Procurement Branch was combined with the Procurement Services Branch to form the new Concentrate Procurement Services Branch, under Frank E. McGinley, former Procurement Services head.

Two other branches underwent name changes: Ore Procurement Branch, headed by Gilman C. Ritter, became the Ore Marketing Branch; and the Planning and Evaluation Branch, with John Klemenic as chief, became the Operations Analysis Branch.

The Division of Raw Materials foreign and domestic procurement responsibilities, formerly under separate assistant directors, have been reassigned to a single newly established position of assistant director for procurement. Thomas B. Upchurch, former assistant director for foreign procurement, has been named assistant director for procurement.

Union Pacific Considers Fe Reduction in Wyoming

•UNION PACIFIC RAILROAD has hired Koppers Co. to study the feasibility of locating an iron ore reduction plant near Laramie, Wyo. Several months will be needed to investigate possible sites, labor conditions, availability of power, water and transportation facilities. The company would not reveal possible location sites under consideration, but there are large deposits of low-grade iron ore in the Iron Mountain area about 35 miles northeast of Laramie, and Union Pacific holds considerable leases in the area.

Union Pacific announced in its 1960 report to stockholders that it has found a satisfactory process for ore reduction.

IN THE U.S.

ALASKA

The state Division of Mines and Minerals reports expectations of another active exploration and prospecting year.

Bear Creek Mining Co., Kennecott exploration subsidiary, will spend another season drilling its copper show on Ruby Creek in the Kobuk country. Mt. Andrew Mining Co. (Utah Construction and Mining Co.) is still exploring and drilling various iron properties in the south part of the Panhandle. Earl Pilgrim is reported by the press to be hopeful of reopening his antimony mine at Stampede in the Kantishna this year.

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It's the modern, effective way to back manganese

Non-metallic NORDBAK streamlines crushing operations of every kind. It's as easy to use out in the field as it is in the plant. You mix it and pour it right on the job...*wherever* your crusher is. No need for special melting or pouring equipment.

NORDBAK fills voids as narrow as ⅛" and is only ¼ the weight of other backing agents. Conveniently packaged, NORDBAK is *the one* modern, effective backing agent for manganese crusher parts!

Use it in gyratory crushers, cone crushers, grinding mills and other machinery where backing agents are required.

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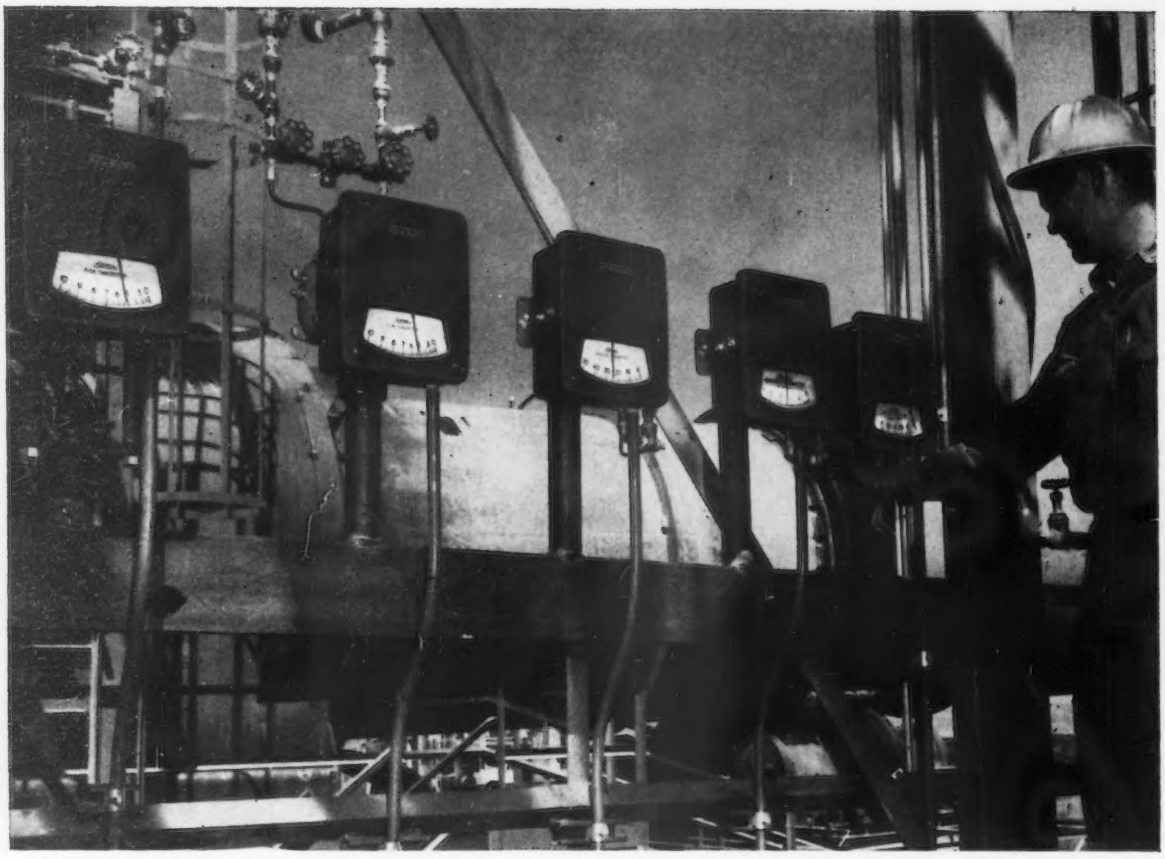


Type 630 indicating electronic Consotrol transmitter — shown here operating in a leading cement plant — may be equipped with any standard Foxboro measuring element. Transmitter continues to measure and indicate even in event of power failure.

Temperature, flow, pressure, speed, level — Foxboro Electronic Transmitters will measure and transmit them any place wires can go

Above ground, below ground — distances up to several miles — Foxboro Electronic Consotrol* Transmitters are the fastest, most accurate way you can transmit a measured variable.

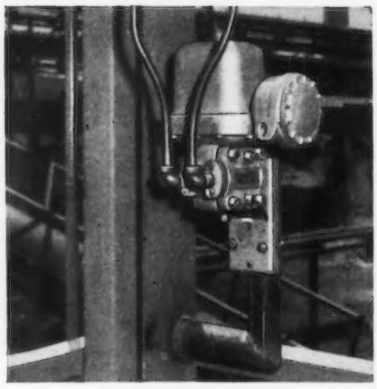
There's no transmission lag. Electric signals are transmitted instantly over two small, unshielded wires to centrally-located recorders and controllers.

Both the Foxboro Indicating and Force-Balance Electronic Transmitters have no vacuum tubes to burn out. Instead, dependable, solid-state components are used throughout to insure years of trouble-free operation.

Zero and span settings are simple mechanical adjustments. And your present personnel will need no special training or skills to operate them.

Foxboro Electronic Transmitters can be mounted anywhere — in any position. Heavy-gauge, tight-gasketed cases completely protect them from dust and weather.

Ask your Foxboro Field Engineer how they can help improve the efficiency of your operation. Or write for Bulletin 21-10 — it tells the whole Electronic Consotrol story. The Foxboro Company, 196 Norfolk Street, Foxboro, Massachusetts.



Type 613 d/p Cell* transmitter combines simplicity and accuracy of force-balance with speed and convenience of electrical transmission. Requires no power supply at the transmitter. *Reg. U. S. Pat. Off.*

FOXBORO

REG. U.S. PAT. OFF.

Alaska *(Continued)*

Two new mining laws have been passed by the Legislature and signed by Gov. William Egan.

Chap. 73 removes the limit on the number of placer claims which may be recorded per month per recording district. It had been set at two per month.

Chap. 123 is a new law providing for staking on certain non-Federal domain lands, and for mineral leasing on lands where staking is not permitted.

The Division of Mines and Minerals also reports a number of requests for information on skin diving possibilities in Alaskan gold streams.

Some of this activity has been going on already, and it appears that Alaska will have many hopeful divers probing stream and lake bottoms throughout the State this summer. For purely prospecting purposes, claims need not be staked, but when prospecting reaches the point where production of gold begins, divers should take steps to properly locate a mining claim or lease the area, depending on whether the land is Federal, State, or perhaps private. Divers should at all times make sure they are not encroaching on others' rights. Also, they are required by law to report to the Commissioner of Fish and Game at Juneau or to a local State Fish and Game office on contemplated operations before doing anything that will disturb the bottom of a stream. Further information can be obtained from the Juneau DM&M office.

Little Squaw Mining Co., Spokane, has shipped seven tons of supplies to the Little Squaw mine in the Chandalar mining district to get ready for the resumption of development work at the gold property this spring. This year the firm hopes to build a four mile road to connect its Little Squaw and Mikado mines in the district. The Little Squaw firm is owned by Metaline Mining and Leasing Co. and Grandview Mines, Inc., both of Spokane.

The AEC has announced that biological surveys associated with its Project Chariot in Alaska are being continued at a reduced level. Project Chariot, a part of the Commission's Plowshare program to investigate the feasibility of using nuclear explosives for peaceful purposes, is proposed as an experiment in making excavations.

The site being investigated for this experiment is at Ogotoruk Creek, near Cape Thompson, Alaska. For the last two years the Commission has sponsored extensive environmental surveys of this proposed site. These surveys have been conducted to provide information from which the Commission could judge the effect which this experiment would have on living organisms. The Commission would not approve conduct of this experiment unless there is assurance that it will not jeopardize the local inhabitants or the plants and animals from which they derive their livelihood. Final authorization for use of nuclear explosives would be given by the President.

ALABAMA

State geologist Walter B. Jones has reported ore samples from Southwest Alabama indicate a large bed of ore of 50% or more iron content.

Jones said ore samples from Barbour County indicate considerable tonnage of high-grade ore in that area. He said ore beds appear in Butler, Henry, Pike, Covington, Barbour and Crenshaw counties.

An estimated 800 more borings are planned in the near future.

State officials suggested a few months ago that Georgia and Alabama are competing for a proposed iron ore operation along the Chattahoochee River.

Mining activity is increasing in the Georgia-Alabama iron belt. Three firms are now shipping ore and a six-month $6,000 drilling program will soon get underway to map out the deposits.

ARIZONA

In his annual report to the stockholders of Inspiration Consolidated Copper Mines, president H. Myles Jacob announced progress on the Christmas un-

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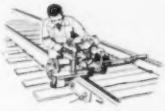
SPIKE PULLER
Versatile hydraulic tool makes quick work of removing spikes even in normally inaccessible areas such as bridges, terminals, etc.

TRACK SHIFTER
To shift track laterally or to raise track vertically, thus considerably reducing the manual effort formerly required for this work.



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Lightweight, compact unit, easily set up and adjusted for fast, accurate work. Simple, self-tightening chuck.

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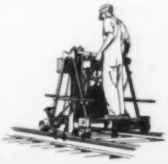
Removes or replaces the nuts of track bolts, fast, and with controlled torque in tightening bolts uniformly.



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This hydraulic machine eliminates another tough manual operation in ballasting and surfacing jobs. Reduces track raising cost and improves final results.

• *Write for further information on any or all of this modern money-saving Nordberg railway track maintenance equipment. Indicate any special problems you may have.*

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Send information on the equipment I have checked:

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I am interested in equipment for the following maintenance operations:

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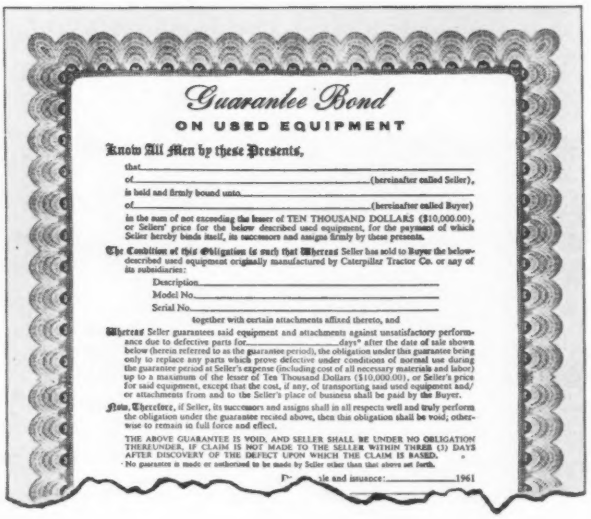
This Bond Is an Investment in You



Guarantee Bond

ON USED EQUIPMENT

Know All Men by these Presents,

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of _____ (hereinafter called Seller),

is held and firmly bound unto _____

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in the sum of not exceeding the lesser of TEN THOUSAND DOLLARS ($10,000.00), or Sellers' price for the below described used equipment, for the payment of which Seller hereby binds itself, its successors and assigns firmly by these presents.

The Condition of this Obligation is such that Whereas Seller has sold to Buyer the below-described used equipment originally manufactured by Caterpillar Tractor Co. or any of its subsidiaries:

Description _____

Model No. _____

Serial No. _____

together with certain attachments affixed thereto, and

Whereas Seller guarantees said equipment and attachments against unsatisfactory performance due to defective parts for _____ days* after the date of sale shown below (herein referred to as the guarantee period), the obligation under this guarantee being only to replace any parts which prove defective under conditions of normal use during the guarantee period at Seller's expense (including cost of all necessary materials and labor) up to a maximum of the lesser of Ten Thousand Dollars ($10,000.00), or Seller's price for said equipment, except that the cost, if any, of transporting said used equipment and/or attachments from and to the Seller's place of business shall be paid by the Buyer.

Now, Therefore, if Seller, its successors and assigns shall in all respects well and truly perform the obligation under the guarantee recited above, then this obligation shall be void; otherwise to remain in full force and effect.

THE ABOVE GUARANTEE IS VOID, AND SELLER SHALL BE UNDER NO OBLIGATION THEREUNDER, IF CLAIM IS NOT MADE TO THE SELLER WITHIN THREE (3) DAYS AFTER DISCOVERY OF THE DEFECT UPON WHICH THE CLAIM IS BASED.

No guarantee is made or authorized to be made by Seller other than that above set forth.

Executed at _____ this _____ day of _____ 19__ and issuance: _____ 1961

Signed by your Caterpillar Dealer, this bond gives you up to $10,000 worth of machine dependability

BONDED BUY

Bonded Buy means guaranteed machine dependability. You can get a completely-checked, used Cat-built machine that has the Cat Dealer's confidence and guarantee, PLUS this bond from Lumbermens Mutual Casualty Company that backs up your machine with as much as $10,000 worth of parts and labor for the period you and the dealer agree upon.

See your dealer. Read the bond. Check the details. This guarantee can apply on your next used machine. And you pay no extra premium for this assurance. Dependable Bonded-Buy machines are priced right—and your Cat Dealer offers terms to match your needs. Call him or see him soon. Do business with the man whose business is built on dependability.

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Arizona *(Continued)*

derground mine as follows:

"Surface construction has progressed on schedule. Hoisting facilities are nearing completion. Heavy crushing equipment is in place, and installation of auxiliaries is well advanced. Concentrator footings and foundations have been completed and installation of heavy grinding equipment has started.

"The McDonald shaft, by the end of March, had been sunk to 1741 ft and concreted to 1716 ft. Planned depth is 1780 ft. Upon completion of dump pockets and skip loading equipment the shaft will be readied for hoisting. Driving of the 1600 main haulage level will then also be done from this shaft as well as from the development shaft. Three headings from the latter shaft are being driven on the 1600 level. Additional pumping capacity has been installed and is capable of handling considerably more than the current inflow of water. The #6 ventilation shaft has been sunk to 1002 ft and concrete-lined to 990 ft. Planned depth is 1205 ft."

CALIFORNIA

"An overly ambitious and unrealistic goal," is the characterization of Project Mohole offered by Dr. George C. Kennedy, professor of geophysics of UCLA. "Their aims are incredible," says the educator. "They want to drill a hole 20,000 ft deep. So far they have drilled down less than 1000 ft. Then they pulled up their drills and quit. Now they want a bigger barge and more money.

"The $50-million earmarked for Mohole could support five times current geophysics research for the next 10 to 15 years," Dr. Kennedy said.

S. H. Williston, Palo Alto, Calif., vice president of Cordero Mining Co., said U.S. mercury production had been cut 40 per cent in last six months because of mine closures.

He reported at a Salt Lake meeting of miner-delegates to the Western Governors Minerals Advisory Council.

Mr. Williston listed as shut down recently "because of foreign imports" the Bretz and Bonanza mines in Oregon and the Altoona and Almaden in California.

A. J. Teske, Boise, Ida., chairman of the miner group, said employment in Idaho's Couer d'Alene district has dropped in last ten years from 7000 to 4500 miners. Mr. Williston said California's mining industry was 96.2% shut down while Fay Bristol of Oregon's state department of geology, Grant's Pass, Ore. said his state's metal mines were "98% closed."

Charles Willis, secretary of the Arizona Small Mine Operators Assn., said "majority of Arizona copper operators are for continuing a 10% reduction in output." Kennecott Copper Corp. recently announced its return to capacity operations.

The outlook for sand and gravel mining in California is bright, but metallic min-

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Eighteen convenient smelters and refineries

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LEAD SMELTERS
Selby, California
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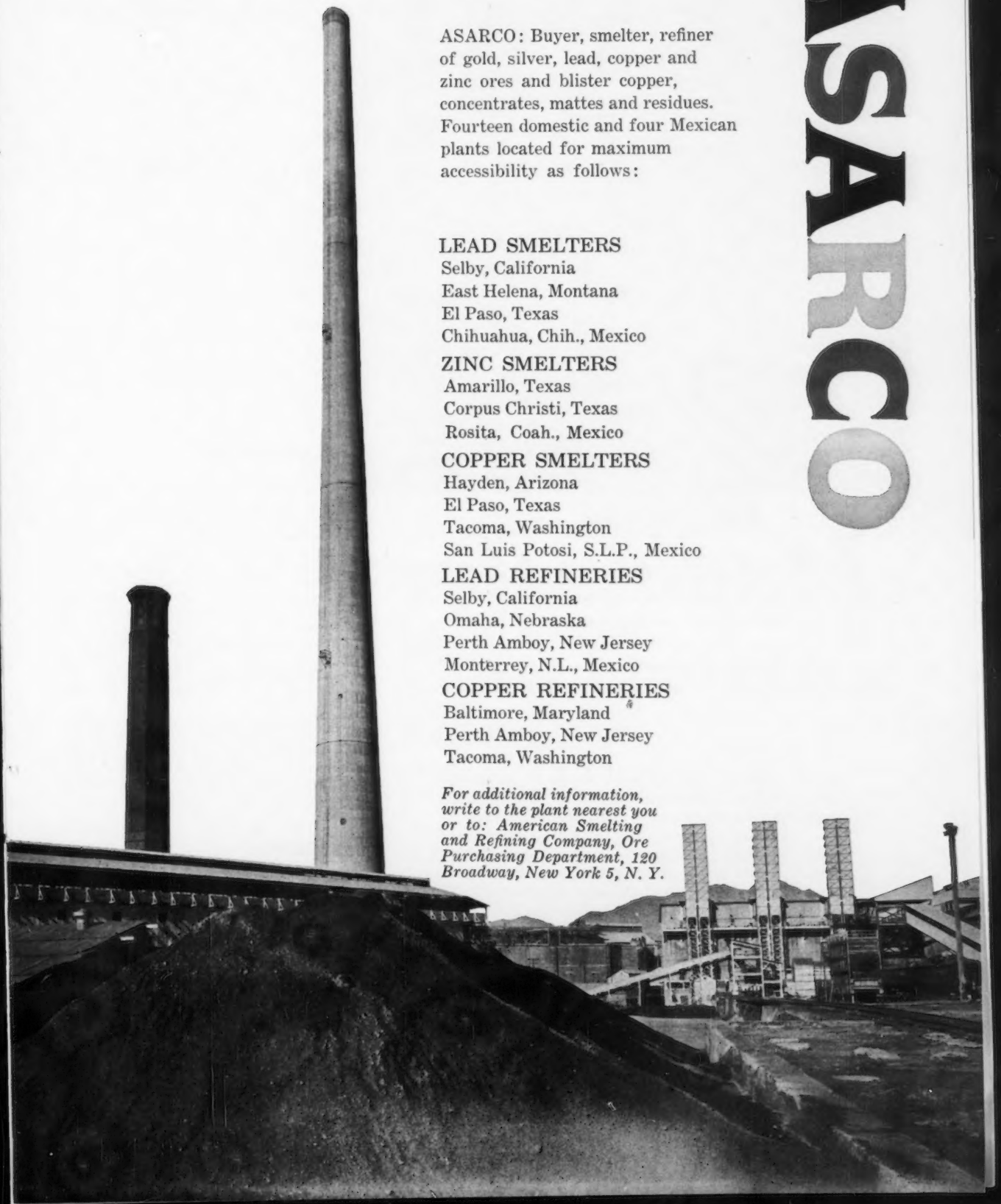
For additional information, write to the plant nearest you or to: American Smelting and Refining Company, Ore Purchasing Department, 120 Broadway, New York 5, N. Y.



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Proved a profit-maker by many dozens of progressive operators, the Mudmaster Log Washer is a powerful, rigid, efficient and economical machine—outstanding for low-maintenance performance . . . effective for cleaning gravel, limestone, phosphate, manganese, iron and other ores. Now with 12" Log models to supplement 10" Logs previously available, the Mudmaster is made in 20', 25' and 30' lengths. *Write for New Bulletin and Price Data.*

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HOLLIDAYSBURG, PENNSYLVANIA

Pit, Mine and Quarry Equipment Headquarters Since 1835

California *(Continued)*

ing will not fare so well, according to a report by Stanford Research Institute.

SRI just released a 456-page study, "The California Economy: 1947-1980," which provides basic information on expected developments in the state's economy in terms of industrial growth, regional development, and population increases. The research, by a 12-man team of economists, was begun in 1958.

Total employment in mining (excluding oil and gas) has increased slightly in the state over the past 10 years, and a further gradual increase is projected. The growth component is production of sand and gravel, which should continue to be good because of continued high volume of construction. Employment in this component is projected to be 15,500 by 1970 and 17,500 by 1980. Non-metallic mining and quarrying are spread throughout the state.

During the 1950's, employment shifted from the Sacramento-Sierra Nevada region to the Los Angeles Metropolitan region. This was caused by a decline in gold and silver mining in the Sierra, and by increased iron-ore mining and sand and gravel quarrying in the Los Angeles region. The pattern of 1957 is projected to 1970.

COLORADO

Consolidated Parnett Corp., of Denver, has announced commencement of work to reopen the Wellington Mine, near Breckenridge. Charles O. Parker, general manager of Consolidated Parnett, noted that once rehabilitation of the old base metal producer was completed, a winze will be sunk and a crosscut driven at a new level 230 ft below the present tunnel. Future plans call for the installation of a 150-ton selective flotation mill at the portal. The mill will be installed after drifting and raising have been completed on the orebodies from the new 230 ft level.

The ore from the Wellington Mine has run as high as 19.6% lead and 22.9% zinc with commercial quantities of gold, silver, and copper. The mining average has been 9% lead, 13% zinc, 3 oz silver and 0.05 oz gold.

IDAHO

Lucky Friday Silver-Lead Mines Co., Wallace, said mill output at the Lucky Friday mine near Mullan will be stepped up in September when a new main hoist goes into operation. Output will be increased to about 700-tpd from the current average of 643 tons.

Production from the "Sun Con area" of the Sunshine Consolidated property at Kellogg, Idaho, was 5156 tons containing 123,885 oz of silver in 1960, W. M. Yeaman, Yakima, Wash., president, says in his firm's annual report. The tonnage was mined between the mine's 3100 and 3200 levels, Yeaman said. Recent opera-

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G.N.S. No. 5	7.76	0.932	1.482	200	212	220	167	Inf.	0.5%

*Basis: Toluene = 105

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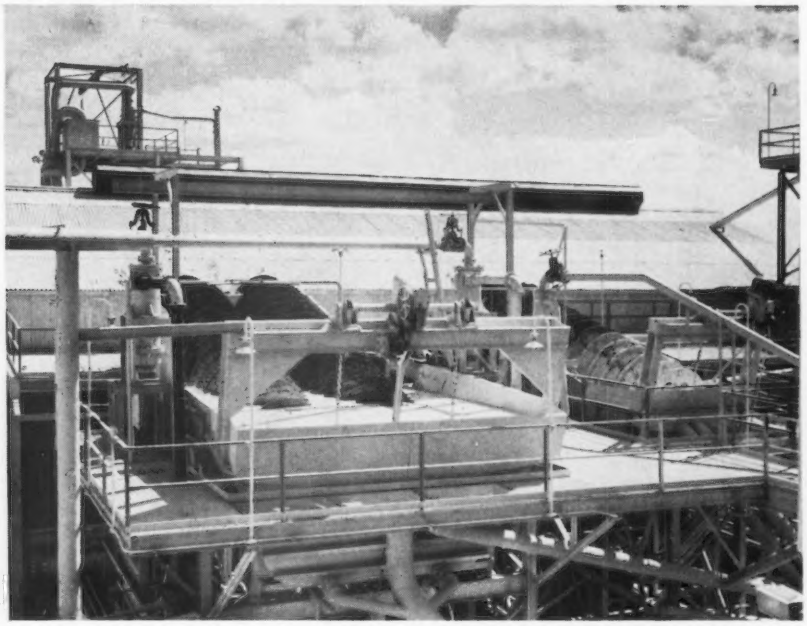
AGELESS AKINS

1934 Akins Simplex Classifier still giving Dependable Performance for Virginia-Carolina Chemical Corp.



The 78"-Akins Simplex Classifier, built in 1934, is dewatering coarse feed in a special flotation circuit. The new 72" Akins Duplex Classifier, with flared tank and serrated shoes, is dewatering and desliming flotation feed. Photo shows three of more than 200 Massco-Grigsby Pinch Valves purchased by Virginia-Carolina Chemical Corporation.

Working Beside New Akins Duplex

The 78" Akins Simplex Classifier, built in 1934 for a large mining company, was acquired by Virginia-Carolina Chemical Corporation in 1956. Based on its dependable and efficient operation the company purchased a 72" Akins Duplex Classifier and a 60" Akins Simplex Classifier for its Clear Springs phosphate plant in Florida. These classifiers were sold and serviced by Mine and Smelter's Sales Agent, R. H. Clark Equipment Co., Inc., Mulberry, Florida.

"Ageless" Akins Classifiers, for washing, desliming, dewatering, size separation, and closed-circuit grinding, are available in sizes from 12" to 84" spiral diameter, simplex and duplex, with standard or submerged spiral. Sand raking capacities up to 7860 tons per 24 hours; overflow capacities up to 2386 tons per 24 hours.

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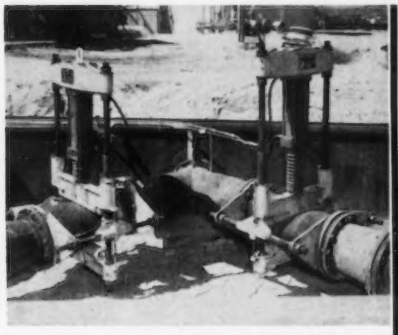
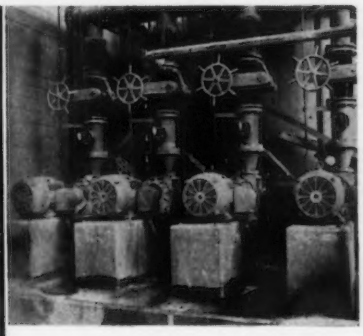
Virginia-Carolina Chemical Corp. Selects Massco-Grigsby Pinch Valves for New Phosphate Plant

200 Valves—sizes from 3" to 10"—types from handwheel to automatic operation.

Based on its previous experience with a large number of Massco-Grigsby Pinch Valves in its plants at Homeland and Clear Springs, the Virginia-Carolina Chemical Corporation purchased approximately 200 M-G valves for its new phosphate plant at Nichols, Florida. These valves were sold and serviced by Mine and Smelter's Sales Agent, R. H. Clark Equipment Co., Inc., Mulberry, Florida.



Two 12" Massco-Grigsby Hydral-Air Pinch Valves on mill tailings line at the Clear Springs Plant of Virginia-Carolina Chemical Corp. Valve system includes solenoids for remote push button control of opening and closing the valves.

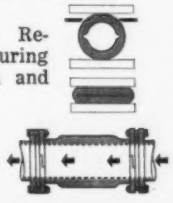


Four 6" and four 8" Massco-Grigsby Pinch Valves on the suction and discharge sides of the pumps at Virginia-Carolina Chemical Corporation's new Nichols plant.

Photo courtesy of Westinghouse Electric

Special Advantages of Massco-Grigsby Valves

- Rubber, Neoprene and special compounded rubber sleeves for corrosive and abrasive pulps and liquids.
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.
- Unobstructed flow eliminates high friction loss, prevents contamination.



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The Massco-Grigsby Hydral-60 System consists of one or more pinch valves with a single automatically operated hydraulic pump which may be operated by electric motor or air from normal plant supply system . . . permits controlled circuitry for any operating requirement.

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Idaho *(Continued)*

tions have included the driving of two long diamond drill holes southwesterly and northwesterly from the west face of the 3100 level. Two vein structures were cut, and lend encouragement to there being more orebodies in the Sunshine Consolidated property, Yeaman told stockholders.

About $5-million in wages were lost by North Idaho workers during their 7½-month strike against the Bunker Hill Co. at Kellogg during 1960, the firm's annual report discloses. The report listed 1960 payroll costs at $10,966,881, down from the $16,085,953 payroll of 1959, when the mine worked throughout the year. The company reported a net loss of $4,-326,932 on 1960 operations.

Golconda Lead Mines of Wallace has purchased 1500 shares of Lucky Friday Silver-Lead Mines Co. stock, increasing its holdings in that rich silver-lead operation to 156,000 shares, most of it acquired for 10c a share years ago in financing the Lucky Friday firm to production. Lucky Friday is currently quoted above the $20 level on the American Stock exchange.

Golconda is the second largest stockholder of Lucky Friday, being exceeded only by Hecla Mining Co., which owns 498,382 shares. Newmont Mining Corp. holds 143,076 shares of Lucky Friday.

Stockholders of Clayton Silver Mines,

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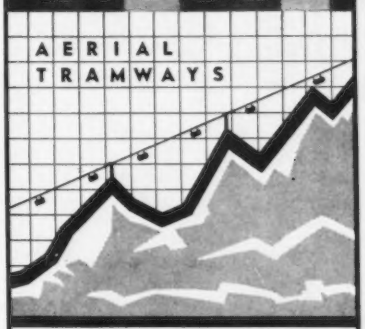

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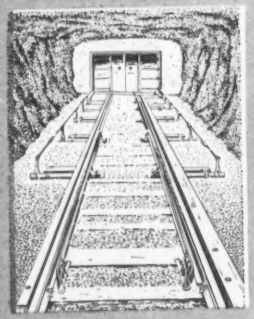
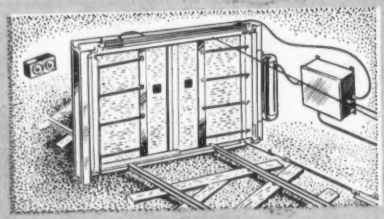
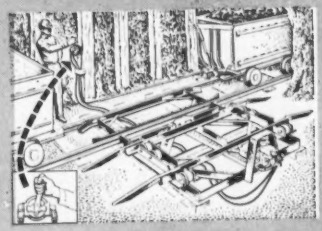




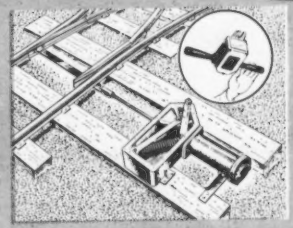
Canton Automatic Mine Doors

The Automatic Door operates mechanically by weight of car on activating levers. Air power operation may be had where desirable. Operates at any trip speed. Two doors provide air lock.



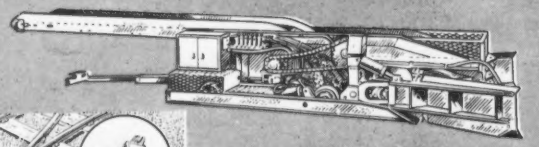
Air Power Car Transfer

One man does the work of three and faster. Entire train loaded out on a single track. Expedites servicing cars to mucking machine.



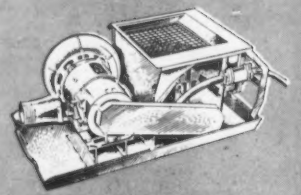
Track Switch Thrower

Either electric or air operated. Route selections made by motorman at full trip speeds. Eliminates accident potential and extra man. Also ideal as Derailer. Manual or automatic contactors available.



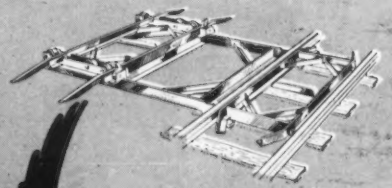
Canton Track Cleaner

Clean entire track area mechanically in one pass—no costly hand labor, no dozers or loaders required—hydraulic controls throughout. "Pays for itself in one sweep through mine." Now used in coal, iron, copper, lead, potash, and salt mines.



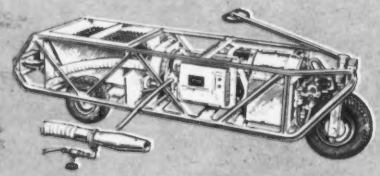
Mighty Midget Duster

Weighs only 280 lbs. Easily moved on shuttle car. Hand cart available. Ideal for small mines—inexpensive—capacity 7 tons dust per shift.



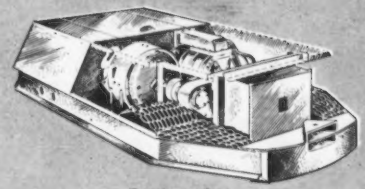
Manually Operated Car Transfer

No alterations to track—quickly installed and relocated—less rib to shoot than for jump switch—no hazards of cherry picker, anti-friction bearings for easy hand operation.



Little Chief for Wet Or Dry Dusting

Rubber tire model 22½" high—skid model 18½" for shuttle buggies, belts or mine cars; hydraulic self-propelled model available. 34 to 60 lbs. dust per minute through 50 to 250 ft. of 2" hose.



Dustmaster

The track mounted Hi-pressure "Dustmaster" is the most powerful Duster ever built. Distributes dust to back areas 500 feet from haulway.

Canton Cable Splicers

Reduce down-time in splicing cable. Machine man should carry a pocketful. Just pound around cable and keep on working. No special tools required.

The American Mine Door Company

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Idaho *(Continued)*

with underground operations in south central Idaho, were told at the firm's annual meeting in Wallace this spring that the company's operations have been at a loss of $13,000 for the first two months of 1961 and that the outlook for the future is "no better under current metal prices." W. Y. Yeaman, president, and Norman M. Smith, general manager, made the reports. Smith said it was the company's intention, however, to continue operations despite the losses because of the heavy pumping and maintenance expense that would accrue were the mine to suspend. The mine, located near Clayton, has "plenty of ore available and its future is favorable if metal prices are boosted," Smith said.

A new $100,000 mine and concentrator assay laboratory went into operation in April at the Bunker Hill Co. plant in Kellogg.

Irving Laskey, chief mine assayer for the company, said the new laboratory unit replaced a facility originally constructed in 1899.

ARTHUR COOPER, metallurgical chemist for Bunker Hill Co., is handling a fire clay crucible while running a fire assay for silver at Bunker Hill's new $100,000 assay laboratory at Kellogg.

The new laboratory is housed in a one-story masonry building with a two-thirds basement. It has about 4200 square feet of space on the main floor and another 2500 square feet in the basement.

Laskey said initial plans for the project date back to 1940. It was delayed at that time because of the war. Later it was postponed because other projects had a higher priority and because of depressed conditions in the lead and zinc industry. It includes weighing rooms, offices, furnace room and a large laboratory area.

A unique ventilating system has been installed in the building. It includes individual outlets at each filter funnel

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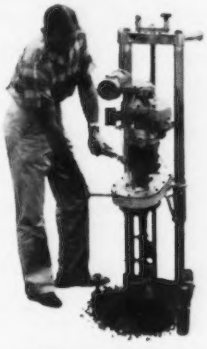

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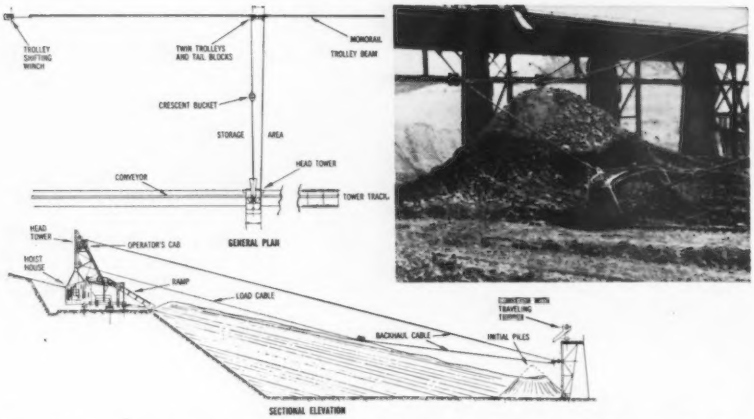
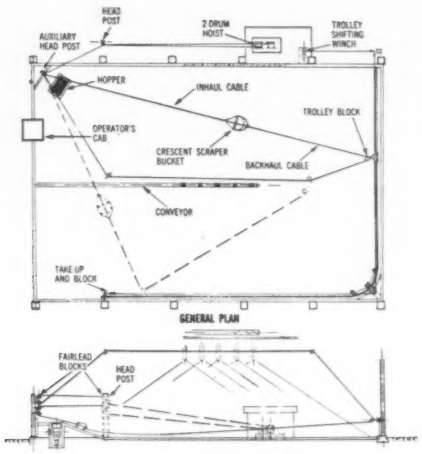


Ore from tripper forms initial piles which are stocked out by the Crescent bucket. The bucket reclaims in the same direction, rehandling the ore as required and hauling it up the ramp on the head tower. Ore drops through hopper opening onto feeder which places it on a belt conveyor running beneath the tower the length of the storage. The head tower and tail trolley assemblies travel in parallel lines so that storage and reclamation of various ores can be accomplished without intermixing. Inset photo shows one of windrow piles formed along trestle. Monorail, trolleys and tail blocks are in background.



Layout drawing shows a Sauerman DragScraper installation used to reclaim material from indoor storage piles formed by overhead conveyor. A monorail extends along one side wall and end wall of building. It carries a trolley and tail block used to shift the backhaul cable. Overhead blocks are used when storage is full to keep cable above piles. Operator controls hoist and Crescent bucket from station above hopper. Photo shows Crescent reclaiming to hopper in corner of storage area.

Sauerman Machines stockpile and reclaim bulk materials from buildings, bins and ground storage piles. The Crescent scraper bucket can deliver directly to one or more hoppers at ground level, to conveyors and processing machines or up to a ramp to an elevated hopper.

Users of DragScraper Storage Systems find this equipment handles material at less cost per ton than other methods of stockpiling or reclaiming. DragScrapers are economical to operate in limited indoor storage facilities or ground storage areas of several acres or more. Materials handled vary in weight up to 200 lb. per cu. ft. Sauerman Machines are built in sizes from ⅓ to 15 yd. to match your tonnage requirements.

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Linden 4-4892 • Cable CABEX—Bellwood, Illinois

Crescent Scrapers • Slackline and Tautline Cableways • Durolite Blocks

Idaho *(Continued)*

along the filtering tables. Equipment includes two heavy-duty electric furnaces, a gas-fired furnace and an electrolytic assay unit.

J. C. Kieffer, manager of the northwestern mining department of AS&R said at Wallace that the company "has no intention of closing the Page mine," an underground operation located near Kellogg. He pointed out, however, that it is a company policy that each mine which the company operates "must stand on its own feet."

Twenty-one states were represented by geologists and mining men who visited the Coeur d' Alene district on a field trip preceding the annual meeting of the Association of American State Geologists at the University of Idaho in April. The Lucky Friday, Dayrock, Galena, Sunshine and Bunker Hill mines were on the schedule of their visitation. Dr. E. F. Cook, dean of University of Idaho college of mines and director of the Idaho bureau of mines and geology, was at the head of the party.

Silver Dollar Mining Co. reports a 1960 net income of $44,627 compared with a 1959 net loss of $7715. The company's principal mining operation is in the so-called "unit area" of North Idaho and it also has Canadian and Oklahoma oil interests. Elmer E. Johnston, Spokane, Wash., is president of Silver Dollar.

A series of rock bursts, the most serious of which shook buildings in the Wallace-Kellogg section, caused extensive damage in the Asarco Galena mine this spring. The immediate site of the "shakes" was along the Silver vein on the mine's 2400 level, J. C. Kieffer, manager of the northwestern mining department of the company, said. He said they were undoubtedly "triggered" by blasting that had taken place in stopes in that part of the mine. No workers were injured but there was considerable sloughing of ground, timbers were broken and tunnel tracks twisted. Air and water lines were disturbed but not seriously damaged, Kieffer said.

Sinking of the new No. 3 shaft at the Galena mine west of Wallace is progressing steadily, J. C. Kieffer, manager of the American Smelting and Refining company, reports. He said steel sets are being used in the shaft—the first use of steel for shaft ground support in the Coeur d' Alenes of Idaho.

MICHIGAN

The Ironwood Mine Corp., Ironwood, announced April 18 that the North Range Co., which has been operating the Penokee Iron Mine near Ironwood, would terminate its lease next Nov. 30.

C. C. Taylor, Ironwood president, said that every effort would be made to get North Range to reconsider, and that other mining firms would be approached

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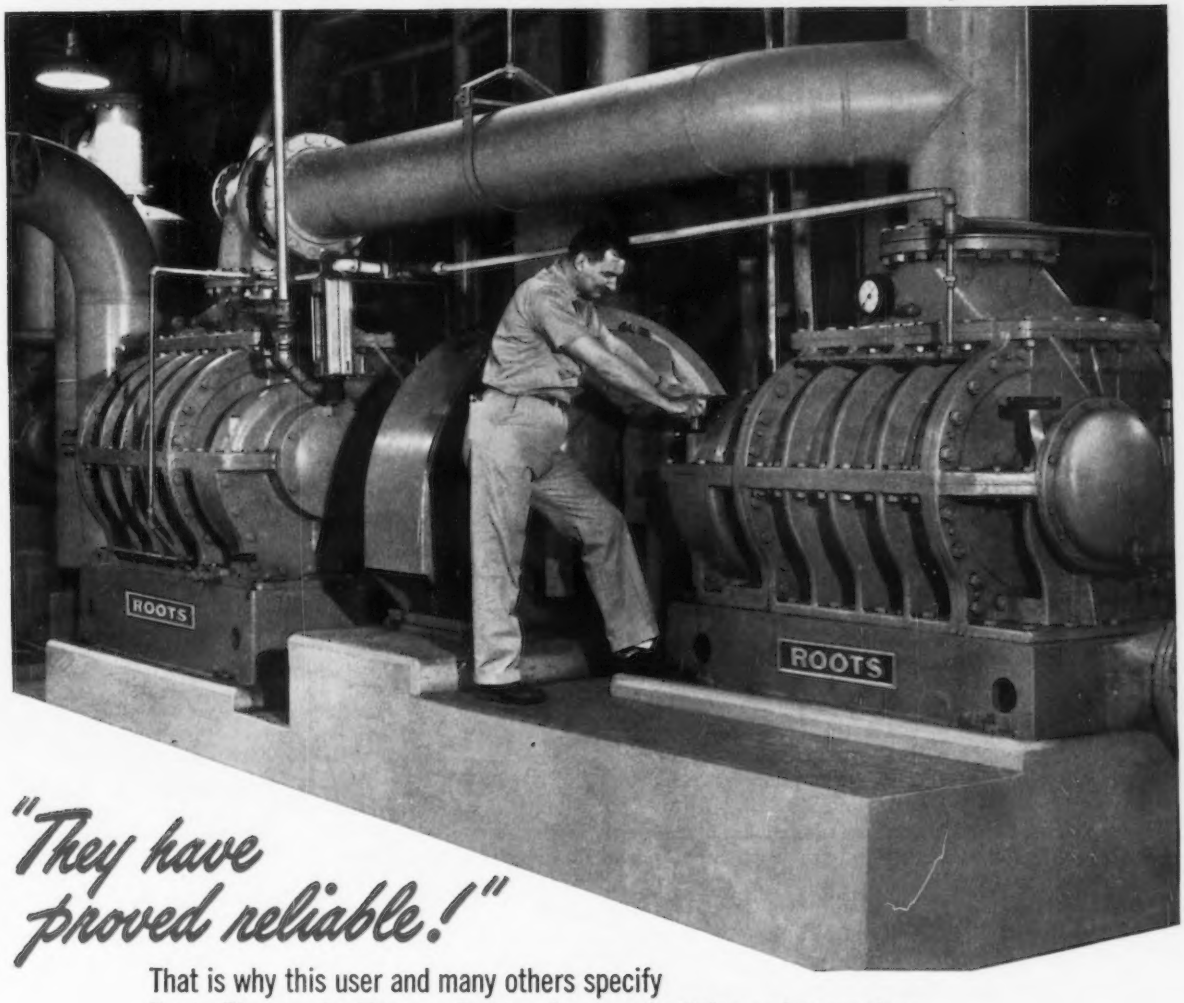

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*Poly-KLEENSLOT
PREPARATION SCREEN

Primarily designed to increase screening efficiency where flats and slivers are present in the material to be screened. The same advantages and efficiencies of our other Wedge Wire products are typical in this new design, including the same open area as a regular long slot screen, plus the non-blinding feature due to increased angle of passage on all sides of apertures. Wedge Wire Poly-Kleenslot is built with Independent Flexing Action — an inherent Kleenslot feature that creates a screen that is non-blinding, non-clogging and flexible while rigid to last longer on even the most rugged applications.

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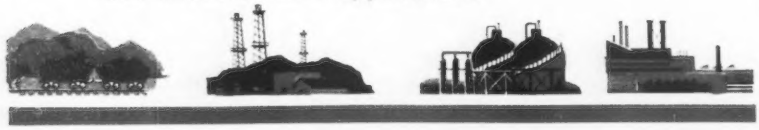


Michigan *(Continued)*

in hope of keeping the mine in operation. Some 300 persons are employed in the mine.

Out of 29 one ton samples from various western Upper Peninsula areas, four have shown a possibility that their iron content could be commercially extracted by known methods of ore beneficiation. One of the four is the ton sample from the Iron River-Crystal Falls district. Michigan Tech's mineral institute at Houghton has been testing lean ore samples from the Upper Peninsula for the past two years. The Iron River sample was from a lean ore deposit near enough to the surface to permit open pit mining. Theodore Pearce, Michigan Tech public relations director, said "we are extremely encouraged about these four samples. Franklin Pardee, consulting geologist and former state mine appraiser, estimates that there are 1-billion tons of low grade ore at fairly shallow depths between Crystal Falls and Iron River.

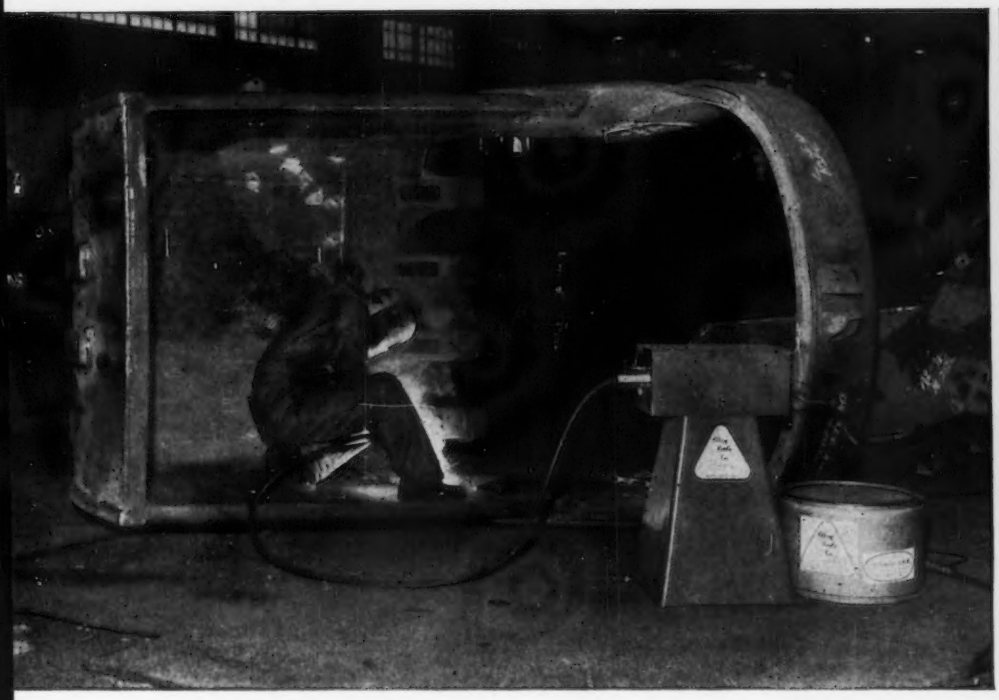
MINNESOTA

The Pittsburgh Steamship division of U.S. Steel opened the 1961 sailing season in early May with the loading of the Cason J. Callaway at Two Harbors, with iron ore for lower lake ports.

The company indicated that some 29 ships would be activated for the season.

A step aiming to attract further investments in taconite and semi-taconite plants in Minnesota's iron ranges was taken March 24 when a bill was introduced, sponsored largely by St. Louis county legislators, calling for a constitutional amendment for taxes on such plants: an action long urged by the mining companies. The bill provides for placing before voters next year the proposition that adjustment of taxes paid by mining companies on taconite and semi-taconite operations be added to Minnesota's constitution. The amendment would provide that occupation, royalty and excise taxes imposed on such operations would be no more than the greater of (1) the amount the taxes would be if computed under laws in effect on Jan. 1, 1961 which have made some considerable concessions to taconite operations. Or (2) the amount that would be payable under manufacturing income, franchise and excise taxes as enacted or amended from time to time by the legislature. Governor Elmer L. Anderson has urged adoption of the amendment to assure investors in Minnesota taconite development that they would not be singled out for heavy taxation as the state's tax income from high grade ore decreases. The amendment as presented would not require a reduction in present taxes; nor would it place the industry under the state income tax instead of the present system of occupation and royalty taxes. A provision of the bill would prevent the amendment from going into effect until taconite and

NEW WEAR-O-MATIC WH Produces High Strength Manganese Attachment Welds Equal to 308 Stainless For PAGE ENGINEERING COMPANY



The Page Engineering Co. was founded in 1903 by Mr. John W. Page who originated the dragline method of digging. Today Page Engineering is the nation's leading manufacturer of dragline buckets, walking draglines and other equipment used in dragline operations.

High strength properties and crack free deposits are the two major requirements for welding alloys used to attach manganese parts to PAGE AUTOMATIC BUCKETS made of high strength alloy steel. Until recently, only type 308 stainless manual electrodes satisfactorily met both requirements. Other alloys have been tested from time to time but failed one or both tests leaving Page no choice but to continue using 308 stainless electrodes for critical joints.

Now, new Wear-O-Matic WH semi-automatic wire developed by Alloy Rods Company fills both the requirements by producing high strength properties identical to those of 308 stainless electrodes while depositing absolutely crack-free weld metal. The Page Engineering Co. has replaced most 308 stainless welding in their dragline bucket production with new Wear-O-Matic WH alloy, gaining the economies of semi-automatic open arc welding and retaining the same high strength requirements for manganese attachment welding. Page engineers report Wear-O-Matic WH gives them the additional advantages of faster deposition and smoother arc characteristics—better than any semi-automatic wire they have ever used in the production fabrication of dragline buckets.

You too, can benefit from the experiences of Page Engineering. For any application involving the high strength attachment welding of manganese, whether it be production fabrication of manganese parts or field maintenance, Wear-O-Matic WH will do the job better than any alloy you are now using and do it semi-automatically. Contact your Alloy Rods Company distributor or Hard Surfacing Specialist for specific application information. Or write direct to Alloy Rods Company, P. O. Box 1828, York 49, Pennsylvania.

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TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES

Minnesota *(Continued)*

semi-taconite facilities had attained an annual capacity of 19½ million tons. Authors of the amendment state that this figure is only about 3 million tons above present capacity; and that the smaller mining companies, by combining, should be able to span this gap without waiting for the Oliver Iron Mining Div. to construct a large plant. They estimate the cost of a one million tons per year plant at $30 to $60 million. A second bill, approved by the forestry committee and which might become important to the mining industry, would permit leases of 50 years on county tax forfeited lands.

Reserve Mining Co. paid to the state of Minnesota over $708,000. for 1960 taxes, consisting of $306,187 production tax (starting at 5¢ per ton and ranging upward, based on the iron content of pellets) and $401,905 railroad tax.

The Lake Superior Mines Safety Council held its March 5 meeting in Duluth. L. J. Hall, safety supervisor for Reserve Mining Co. at Silver Bay, was general chairman. He acted as discussion leader on the topic "Communications in Safety for Supervisors." Four 10 minute National Safety films were shown for this subject. W. O. Gunnelson, Hibbing, safety supervisor, M. A. Hanna Co., talked on "Improved Communications at Hanna Safety Meetings Through the Use of a Polaroid Camera for Preparing Visual Aids." S. B. Slade, safety inspector, Jones & Laughlin Steel Corp., headed a discussion on "Safety Meetings." "Accident Reports and Their Dissemination" was discussed with Al Kolu, Duluth, assistant to the supervisor of safety, Pickands Mather & Co., as leader. Secretary of the Council is Allen D. Look, Duluth, of the U. S. Bureau of Mines.

Rhude Media Co., Inc., west of Marble, has reopened for its 12th season of producing ground ferro-silicon (in 48 mesh and 65 mesh sizes) for heavy media plants on the Mesabi range. J. R. Sheehy is manager of the plant.

Pickands Mather & Co. has announced that its West Hill mine, between Coleraine and Grand Rapids, idle since 1958 when 31,314 tons was shipped, will be reopened. The mine contains an estimated 1,398,340 tons. About 42 men, now employed at the West Hill, came from the Tioga No. 2,, the farthest west mine on the Mesabi range.

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SPANGALOY Tools available in stem joints, weldless jars and bits.
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MISSISSIPPI

Mississippi landowners are being urged by the state research commission to make use of Federal grants available for mineral exploration if deposits are known to exist on their land.

The Mississippi Industrial and Technological Research Commission said the Office of Mineral Exploration has said the Department of Interior will pay, if the prospect meets its requirements, 50% of the exploration costs for iron ore and sulphur.

The department also indicated it will pay 75% of the exploration costs for more critical minerals such as berylium, columbium, manganese and tantalum.

"Some quantity of iron ore and sulphur is known to exist in Mississippi and it is believed that berylium, columbium, manganese and tantalum can be found within the state," the research commission said.

Some high grade clays found in the state have also been included by the Interior Department as eligible for aid in exploration costs.

MONTANA

The largest explosion in the Anaconda area's history was witnessed on April 28 when 1½-million tons of rock lime were blasted from the side of the lime quarry operation mountain six miles west of Anaconda.

Phalen Frey, foreman for the F&S Contracting Co., Butte, and Ray Gallant, Denver, formerly of Butte and now a representative for the DuPont Powder Co., supervised the placing of the charge.

The high explosive, 178 tons of it, was placed in three cross cuts of a tunnel drilled 160 ft into the face of the lime quarry.

On April 1, 1960, 68 tons were used

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Rex Outboard Roller Steel Pan Conveyors provide a practical solution to many unusual conveyor problems.

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Other types available for every service—For information on how Rex Apron Feeders, Apron and Pan Conveyors can help you cut production costs, write CHAIN Belt Company, 4679 W. Greenfield Ave., Milwaukee 1, Wis. In Canada: CHAIN Belt (Canada) Ltd., Toronto and Montreal.

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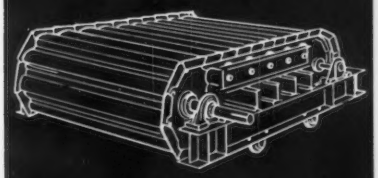
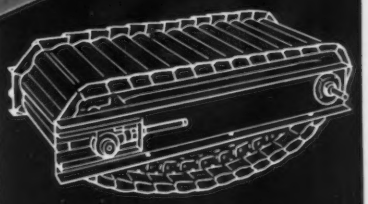
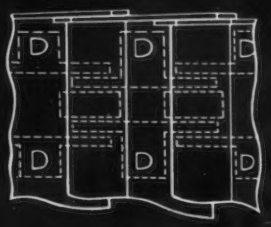
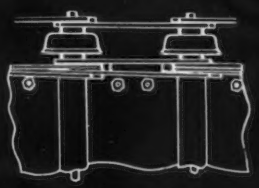


Rex 2342-K21 Heavy-Duty Feeder for primary or secondary application.



Rex 531-K17 Light-Duty Apron Feeder, used under hoppers and bins to regulate material flow.





Style A aprons with Type K or A chain attachments furnished as machinery parts for many applications.

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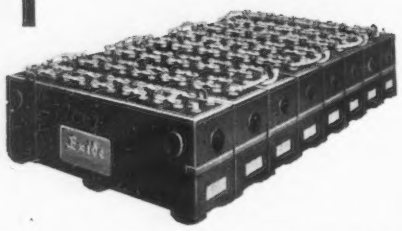

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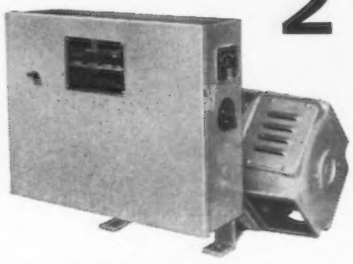

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The complete Exide power package is the lowest-cost way of getting the maximum for your battery dollar investment. Exide service men, factory-trained specialists in Exide equipment, will help you attain lowest cost through long service life. Over 200 specialists located from coast to coast available to give you prompt service when you need it.

For complete information on the economies of the Exide power package, write Exide Industrial Marketing Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide® INDUSTRIAL MARKETING DIVISION (ESB)
The Electric Storage Battery Company

Montana *(Continued)*

in a similar blast at the quarry. It loosened 500,000 tons of lime rock.

Officials of the Anaconda Co. and F&S witnessed the super blast and termed it highly successful. All traffic in the area was stopped for a distance of 500 yd from the quarry.

The lime quarry operation is under contract to F&S which furnished the lime to the Anaconda Co. for use as a flux in its smelting operation. The crushed lime is loaded on 60-ton capacity ore cars and hauled to Anaconda.

The lime is also being used in Silver Bow Creek as a reagent to neutralize acid in the water from Butte mining operations of the Anaconda Co.

WILLIS JOHNS, geologist for the Montana Bureau of Mines and Geology in charge of the Kalispell field office, inspects ore specimen as part of northwestern Montana mineral resources survey sponsored by the bureau and by Pacific Power and Light company and Great Northern Railway company.

Several areas in northwestern Montana appear to offer mineral potential, according to Willis Johns, geologist for the Montana Bureau of Mines and Geology in charge of the Kalispell field office.

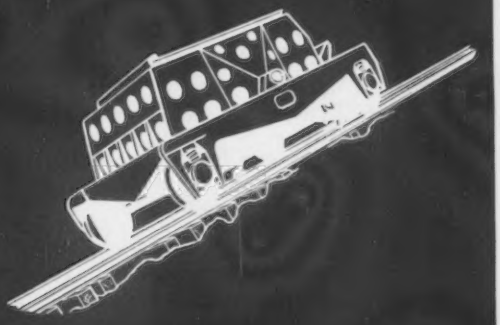
Johns heads a cooperative survey and mapping program in Flathead, Lincoln and Lake counties. The project, started in 1958, is being sponsored jointly by the Pacific Power and Light Co., Great Northern Railway Co., and the bureau.

Areas which indicate some mineral potential include the Libby-Troy area, with lead-zinc-gold possibilities and some copper and silver; the Hog Heaven district about 20 miles southwest of Kalispell, with indications of high grade silver ore; and the Eureka area, where there have been showings of barite.

A giant-sized Cryderman mucker is being used at Great Falls, to see what it can do to expedite the sinking of 150 holes for Minuteman ICBM silos.

Contractor, Fuller-Webb Construction Co., has been employing clam shell diggers on the sinking of 60-ft deep holes into which concrete lining will be placed.

HOIST PROFITS
with STRAIGHT-LINE ORE PRODUCTION



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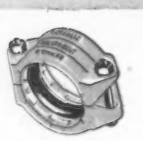
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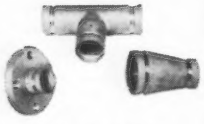
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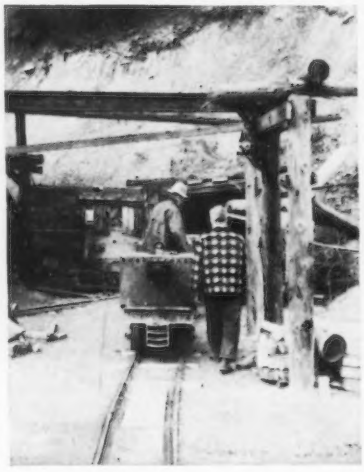
Montana *(Continued)*

The Cryderman will be manned by two hard-rock miners experienced in operating the shaft mucking machine produced by Machinery Center, Inc., Salt Lake City.

Roger V. Pierce, president of Machinery Center, said the experimental model of the Cryderman is mounted on a huge eight-wheel, mobile assembly similar to that employed for heavy artillery. The "head frame" is 30 ft in height, and the mucker stands 54 ft in height when the Cryderman is on surface. During operations, this stand will go to the 60 ft depth of the silo hole. Mr. Pierce expects the pilot Cryderman to dig at rate of three cu yd a minute. It has half-yard mucker shovel.



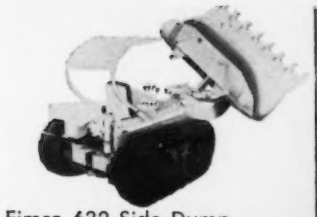
THE TUNNEL at Nancy Lee mine about six miles from Superior, where Ernie Smith, Osburn, Idaho, mining man, is producing about 70 tpd of lead-silver ore. Smith hopes to expand operations at the mine this summer.

Crews at the Nancy Lee mine about six miles northwest of Superior, are mining 70 tpd lead-silver ore, according to Ernie G. Smith, who is leasing the property. Smith, of Osburn, Idaho, said all current ore is being produced at the 790-ft-level but a raise is being put through to the 640-ft level.

Smith has leased the property for the last 17 years. It was reopened last spring and a crew of 13 is operating the mine and nearby mill. He said the property includes more than 60 claims and is believed to be an extension of the Coeur d'Alene mining district of northern Idaho some 40 miles west of Superior. The ore is largely lead-silver but there is some copper. It is being trucked to the company's mill about four miles from the mine, and concentrates are being sent to the American Smelting and Refining Co. smelter at East Helena, Mont.

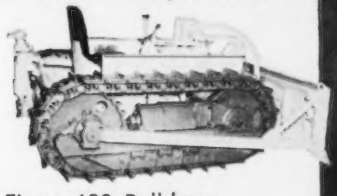
NEVADA

Humboldt Iron Mines Co., which was



Eimco 632 Side Dump

Eimco 631 Hopper-Loader



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Eimco 630 Bulldozer - Compact, powerful Dozer and Prime mover.

Eimco 630 Excavator - Dependable, Economical, Fast high capacity Mucker.

Eimco 631 Hopper-Loader - Designed to load and carry 56 cubic foot payload.

Eimco 632 Side Dump Front End Loader - Low Headroom.

Eimco 635 Continuous Loader - Fast bucket cycle plus integrally mounted conveyor.

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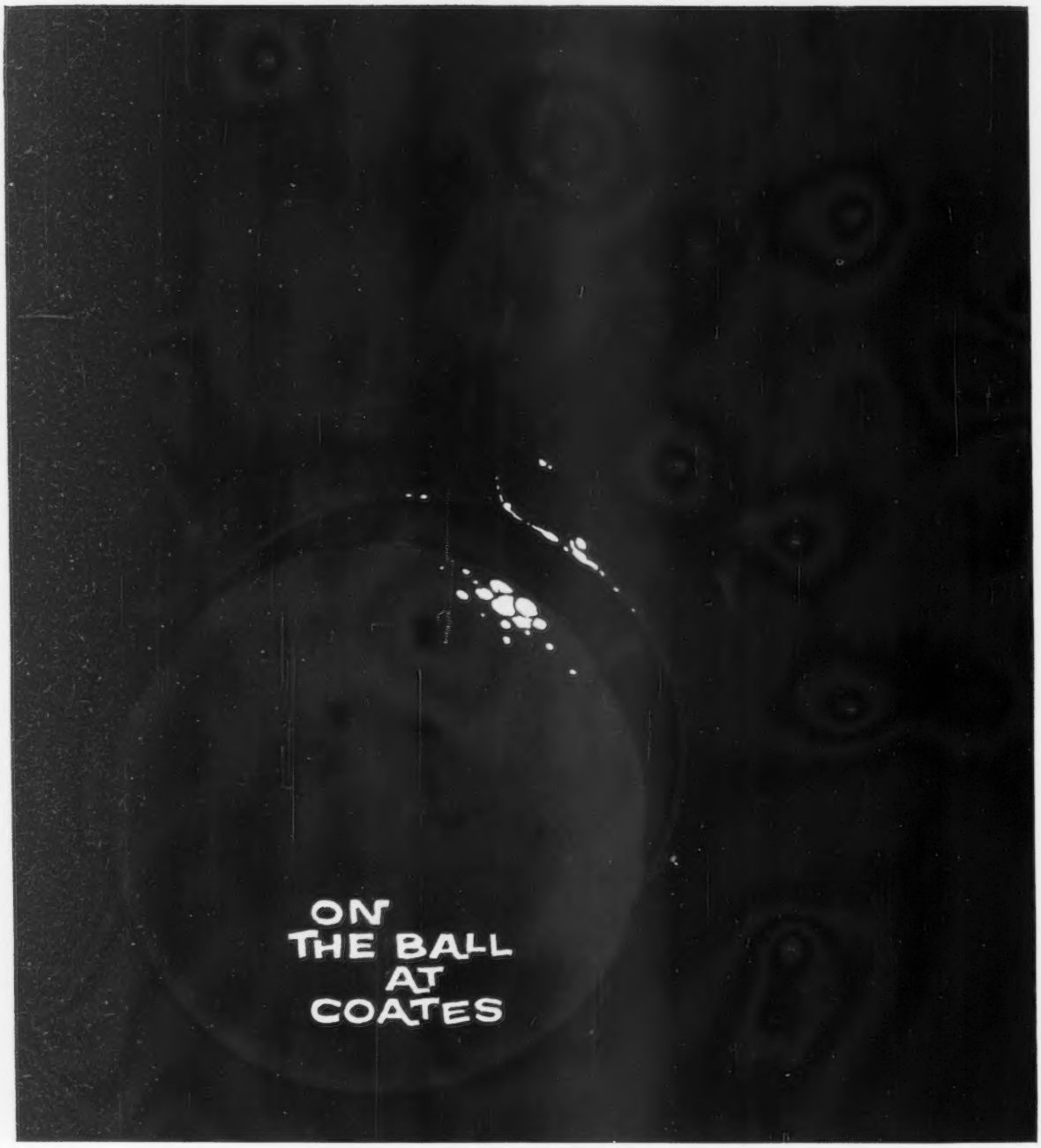

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Nevada *(Continued)*

operating a large open pit iron producing property in the Jackson mountains of Humboldt County, closed operations in April as a result of unexplained earth tremors. Will Austin and Charles Rowe, owners of the property, said large boulders were being shifted by unsettled earth, endangering the men working in the pit. The mine was opened in 1955 and has been a major producer of high grade iron ore. It is near the Iron King mine, Nevada's only underground iron producer.

Manganese Inc. will close its flotation and sintering plant at Henderson, in Clark County, as a result of the recent GSA order halting Government purchase of domestic magnesium. Also due to close as a result of the order are the firm's Three Kids mine, operated by the Isbell Construction Co. under contract, and the Hulin Pit, operated by Mine Contractors Inc. A total of 160 men will be put out of work by the action.

U.S. Milling & Minerals Corp. has begun operating its mill at Silver Peak 24 hours daily, and is processing 200 tpd of gold-silver ore. The added shift was started in mid-April due to increased production from the company's mines. Most of the ore comes from Gold Point, where 36 men are employed in two underground operations. Production was resumed in mid-April from the Mohawk mine near Silver Peak where repair and development work had been in progress for several months previously. R. O. Camozzi is general manager for the Silver Peak operation.

U.S. Steel has completed purchase of Mineral Materials Co. holdings in Mineral Basin, Pershing County. The total price was $5.4-million and included in the deal is the large upgrading mill as well as extensive iron ore claims. Mineral Materials Co. had 29 men employed, but the property has been inactive since purchase negotiations began. U.S. Steel has announced no plans for development of their new holdings.

Centennial Development Co. has 20 men driving drifts and cross cuts in the beryl lium ore deposits in the Mt. Wheeler Mines Co. property in White Pine County. The mine has been leased by Anaconda Copper Co. and Centennial has been awarded the contract for carrying out the development program.

Kennemetal Inc. has 40 men employed at the Nevada Scheelite mine and mill 45 miles northwest of Hawthorne in Mineral County where they are producing tungsten. The men and their families all live on the site. The mine is an underground operation.

U.S. Milling & Minerals Corp. has revived the old mining camp of Weepah in Esmeralda County, and six men are now employed there producing 150 tpd of good gold-silver ore. Work is being done in two shifts from both open pit and underground operations. Walter Simmons is in charge of the work, and ore

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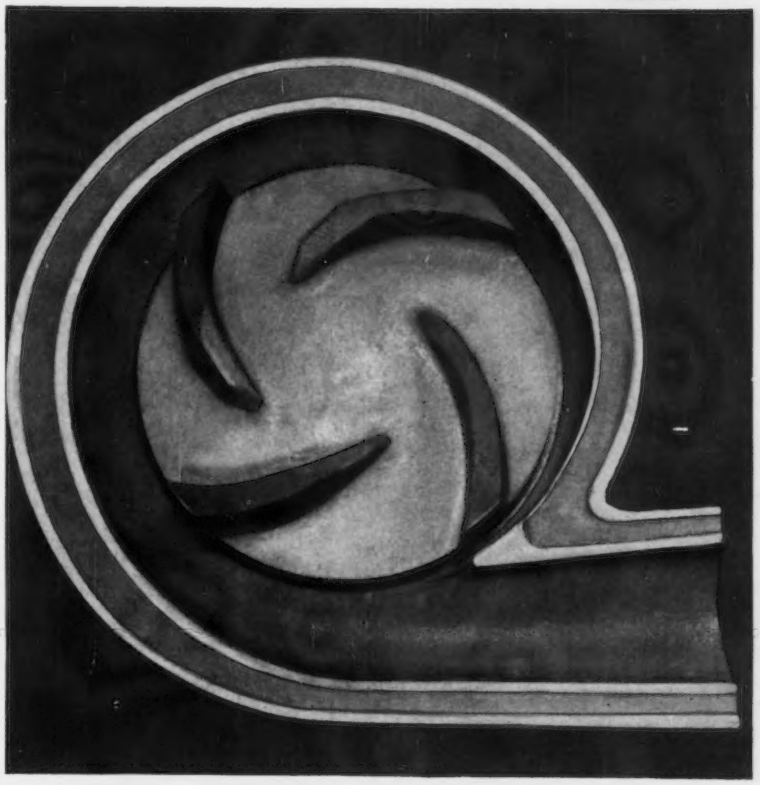

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Almanite W is a special martensitic iron and is an entirely new type of Meehanite metal possessing outstanding wear and abrasion resistance under both wet and dry conditions of service. It is now being used successfully as a replacement for high alloy cast irons and for carbon and manganese steels under **abrasive conditions such as hydraulic mining.**

The Almanite impellor shown was tested at Mt. Morgan Mining Company, Queensland, Australia in a Warman Cyclone Feed Pump used for the pumping of gravel sludges. Test results listed below demonstrate the superior service life of Almanite W over other materials in which this impellor was previously cast.

White Iron	*7 to 8 days*
Alloyed White Iron	*10 days*
Martensitic White Iron	*9 to 11 days*
28% Chrome Steel	*14 days*
Special Nickel Steel	*16 days*
ALMANITE W	*21 days*

Almanite W can readily be cast in all forms and shapes and is available through Meehanite foundries only. For more information, write to Meehanite Metal Corporation, 714 North Avenue, New Rochelle, New York.

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If you have a weight problem...

Our business is solving other people's weight problems. Usually, these problems involve wanting to know exactly how much weight passes over a conveyor in a given time period. Often, the problem is to control the flow of material into a continuous mixing process. And frequently, somebody asks us to help him automate a complete process system, with interlocks, time delay relays, and complete circuitry control systems.

All the problems we solve have two things in common: measurement or control of the amount of material *by weight*, which is a far more accurate way of doing it than by volume; and secondly, the fact that the material is *in transit* during the weighing and controlling.

... there are a number of solutions.

In our existing line of Weightometers® and Feedoweights,® we now have so many different types of standard equipment . . . at last count, it was approaching 200 . . . that there is virtually no existing set of requirements that at least one of them can't answer. We can give you electrical, electronic, hydraulic or mechanical systems. And in the very rare cases where one of our standard models can't be used, we'll engineer one for you.

Moreover, if you already have a conveyor weighing or feeding system in operation, we can automate it for you, no matter whether your arrangement is mechanical, electro-mechanical, hydraulic or electronic. We can do this for you with the new Merrick Rate Transducer.

This is an ingenious device, if we do say so, that can be fitted to any Merrick Weightometer, no matter what its vintage. It produces a straight-line voltage output control signal. You can use this to control or provide information in a whole host of different applications. With it, you can relate other process steps to your conveyor feed. Or you can couple your Weightometer to a continuous recorder, or make it feed information into a computer.

As we say, you can order it on your new Weightometers, or we'll be glad to install it on your existing units.

So after fifty-three years in the business, the Merrick line is still the most modern, most adaptable that you can find anywhere. Why not drop us a card? We'll be glad to send you our latest literature.

Merrick

more than fifty years of "firsts" in automatic weighing

MERRICK SCALE MANUFACTURING COMPANY
180 Autumn Street • Passaic, N. J.

for better washing . . . dust control

SPRAY NOZZLES

from Spraying Systems Co.

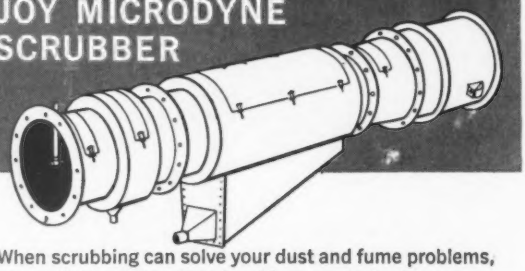
- **complete choice of types and capacities to fit your job**
- **greater efficiency with minimum volume of water**

Proper distribution and impact for washing . . . or proper atomization for dust control without unnecessary wetting . . . these are just some of the advantages of having a complete choice of spray nozzle types and sizes to fit your job. For complete information write for Catalog 24.

SPRAYING SYSTEMS CO.
3215 RANDOLPH STREET
BELLWOOD, ILLINOIS

The COMPACT dust collector that fits into 1/10th the space!

JOY MICRODYNE SCRUBBER



When scrubbing can solve your dust and fume problems, only a WP **Joy Microdyne Scrubber** can do the job so efficiently in so little space.

Needs only a fraction of the space of other collectors . . . weighs far less . . . yet delivers highest efficiency. Installs in existing duct system, in horizontal or vertical position . . . often at the dust source. Steel or corrosion resistant alloy construction.

WRITE FOR LITERATURE today to Western Precipitation, 1000 W. 9th St., Los Angeles 54, Calif. (In Canada, write 8285 Mountain Sights Ave., Montreal, P. Q.)

DUST AND FUME CONTROL SINCE 1907

WESTERN PRECIPITATION

DIVISION OF JOY MANUFACTURING COMPANY

Nevada *(Continued)*

is shipped to U.S. Milling & Minerals Corp. mill at Silver Peak, 25 miles distant.

Apex Minerals Corp., one of Nevada's most active mining concerns, has completed a merger with Interstate Oil and Development Co. and Churchill Exploration Co. The name of Apex Minerals Corp. has been retained for the new combine which operates the Rundberg Mine near Austin where it maintains a large and steady production of uranium ore.

In a discussion of the brucite-magnesite deposit at Gabbs, A. M. Dixon, mine superintendent for Basic Inc., which operates one property in the area, presented its history and some data on the present activity at the southwest mineral industry conference of AIME at Las Vegas in late April.

Vast tonnages of magnesite were developed in the late 20's, but transportation difficulties prevented development until 1936. The war provided impetus, with concentrates being shipped to the Government plant at Henderson, where some 1-million tons were turned to magnesium metal. Of the other 5-million tons mined, most has gone into granular refractory material. During and after World War II, various operators mined the ore from several pits and underground diggings, many of them on lease.

After the war was over the government declared the plants as surplus, and in 1949 Basic Refractories, Inc. purchased the Gabbs oxide plant and mineral land that the government held. All leased properties had been returned to former owners. Plans were drawn to convert the plant so that dead burned granular magnesia refractories could be produced, primarily for the steel industry.

A heavy media separation plant was built in 1950 to upgrade brucitic material and do away with hand sorting.

A 9½x395 ft rotary kiln of 80,000 ton yearly capacity was erected in 1950 to be fired either with coal or oil. At first a wet slurry kiln feed was used. This feed was prepared in the wet grinding circuit of the old flotation plant. Dead burned magnesite clinker was produced early in 1951, and production has continued to date.

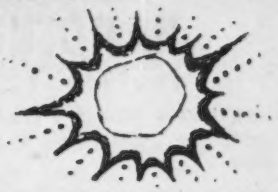
It was thought that a better product could be made by briquetting the kiln feed. In 1953, under the management of H. P. Willard, dry grinding was introduced and briquettes were made. In the meantime, two of the Herreshoff furnaces had been sold. The two remaining Herreshoff Furnaces were rehabilitated and are now in operation producing MgO (oxides).

To make use of the low grade magnesite mined by necessity to get the better ore, a 500 tpd flotation plant was put into operation in June 1959.

In 1960 a second rotary kiln 8½x220 ft of 40,000 tons a year capacity was built as well as a special products plant and oxide grinding and bagging facilities.

All mining is by selective open pit methods using air trac drills, Euclid 15

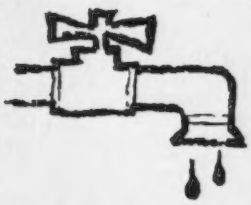
The Getman Brothers' KD-5A Scoot-Crete uses an air-cooled Deutz Diesel.



Reason: no warmup needed. Runs effectively from 40° below to 140° above (and it's approved by the Bureau of Mines.)

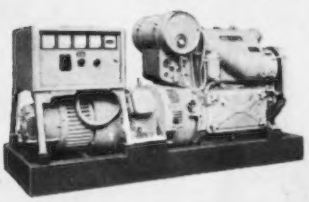
Fuel goes farther—every drop is burned.

So there's less down time—no sulphurous acid condensation—hardly ever a carbon job.

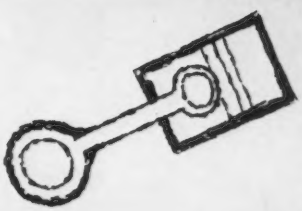


No water system; maintenance bills go down. You get full H.P. rating; no power lost for cooling.

Good reasons why Wagner ore carriers, Wagner scoopmobiles, the Jones Jackass and the Young Shuttle Buggy run on Deutz Diesels, too.



Deutz air-cooled Diesels are also used on generators, compressors, stand-by power equipment.



Complete parts and service facilities right where you need them.

PARTIAL MODEL	SPECIFICATION BHP	TABLE RPM
F1L 712	13	2300
F2L 712	26	2300
F3L 712	39	2300
F4L 712	52	2300
F6L 712	78	2300
F/A3L 514	48	1800
F/A2L 514	32	1800
A4L 514	72	2000
A6L 514	110	2000
A6L 614	110	2000
A8L 614	145	2000
A12L 614	220	2000
A6L 714	125	2000
A8L 714	168	2000
A12L 714	250	2000

Full range: 5 to 250 BHP in 1, 2, 3, 4, 6, 8, and 12 cylinders.

DEUTZ

DIESEL ENERGY CORPORATION
82 Beaver Street
New York 5, N. Y.

Please send catalogs covering the range I have checked.

☐ 10-90 HP ☐ 100-250 HP
I am a ☐ Dealer ☐ Manufacturer
☐ Operator

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Address_____

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EMJ-7

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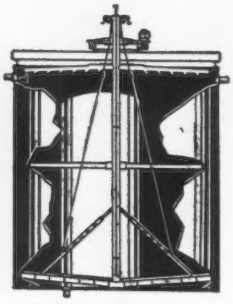
YORK, PENNSYLVANIA

NEW YORK • TORONTO • CHICAGO • HIBBING • HOUSTON • SALT LAKE CITY • SAN FRANCISCO • LAKELAND • BIRMINGHAM

AGITATING

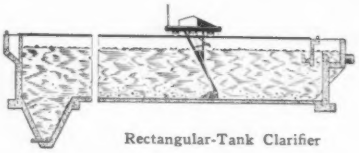
Hardinge combined mechanical and air Agitators are used to mix, agitate or store clay slurries, as well as metallurgical and chemical pulps. Compressed air is delivered to the bottom of the torque tube (which acts as an air lift) and to various points near the ends of the rotating scrapers. Pulp is fed and withdrawn continuously or intermittently, as desired. The drive mechanism is supported on ball bearings in an oil-filled, totally enclosed housing. The scraper raising winch is in easy reach and away from possible splash of pulp. Bulletin 31-E-1.



Agitator

CLARIFYING

For industrial water supply or liquid waste treatment, Hardinge offers clarifiers for both circular and rectangular tanks. The rectangular tank unit is especially suited for limited spaces. A traveling scraper and skimmer carriage travels the length of the tank, running on rails mounted on both sides. Cost of the mechanism does not increase with tank length. Circular-tank units are also available for continuous removal of settling-tank solids, similar in construction to the Hardinge Thickener, (see next page) Bulletin 35-D-1.

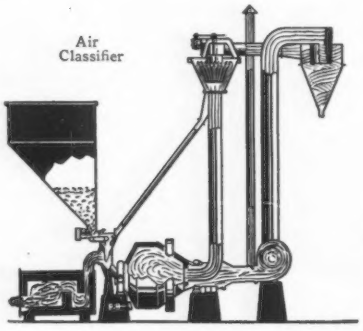


Rectangular-Tank Clarifier

CLASSIFYING • SEPARATING

Dry Classifiers

The Hardinge Gyrotor® Air Classifier, operating in conjunction with the Hardinge Mill, is a compact, self-contained unit of unusual efficiency. The material is conveyed without auxiliary apparatus to any convenient location in the building. The Hardinge Gyrotor Air Classifier provides extremely close product control. Bulletin 17-C-1.



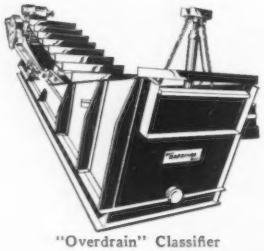
Air Classifier

Wet Classifiers

The Hardinge Hydro-Classifier is a large-volume classifier for fine separating problems. Bulletin 39-C-1.

Hydro-Classifier

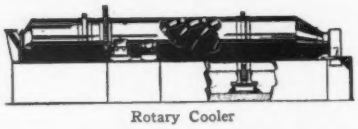
The "Overdrain" Classifier is a completely new device. A belt, with lifting flights attached beneath, moves upwardly out of the sand bed between two stationary side shrouds, creating the effect of a series of moving, closed, washing compartments. The only outlet from these compartments is via holes in the belt above. Surplus liquid and slimes discharge through these "overdrain" holes without mixing with the oncoming sands. Extremely clean sand discharge, excellent de-sliming—an ideal washing device. Bulletin AH-478-1.



"Overdrain" Classifier

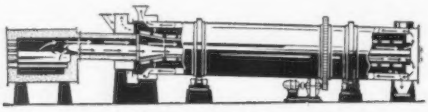
COOLING

Ruggles - Coles® Rotary Coolers are employed for cooling hot materials after high temperature drying or calcination. There are four types: the gas-cooled type, the water-cooled shell type, the internal water-tube type, and the direct-contact water type. Bulletin 16-E-1.



Rotary Cooler

DRYING



Class XB Double-Shell Rotary Dryer

There are six different types of Ruggles-Coles® double and single-shell continuous Rotary Dryers, designed for direct, indirect and steam heat. Bulletin 16-E-1.

Class XA—This double-shell, semi-direct-heat dryer has the highest thermal efficiency and lowest fuel consumption of any rotary dryer manufactured. Particularly adapted for coal drying.

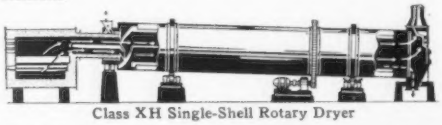
Class XB—A double-shell, indirect-heat dryer designed to handle such materials as Kaolin, chalk, whiting, china clay, pigments, fuller's earth.

Class XC—A rotary steam tube dryer for drying materials that are injured by high temperature such as brewer's grain, cotton seed, starch feed, tobacco stems and corn germs.

Class XF—Single-Shell, counter-flow dryer for high drying temperatures.

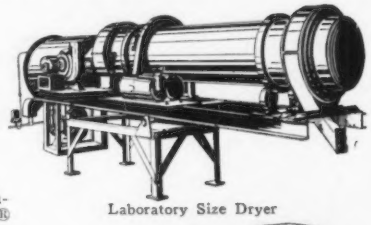
Class XH—A single-shell, parallel-flow dryer, especially designed to handle flotation concentrates without sticking and without excessive dust loss. Applicable to many other uses.

Class XW—Used almost exclusively for drying inorganic salts and similar materials. It is a single-shell dryer with steam coil heating element.



Class XH Single-Shell Rotary Dryer

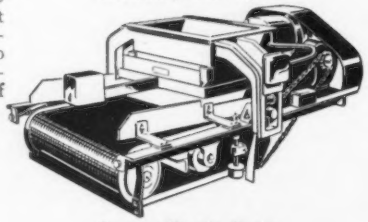
For pilot-plant or laboratory drying operations, Hardinge offers three styles of small, self-contained units, the XH-XF unit, the XB and the XC units.



Laboratory Size Dryer

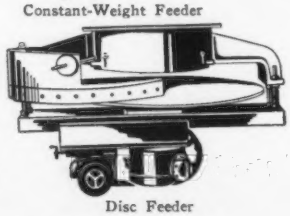
FEEDING

The Hardinge Constant-Weight Feeder® measures by weight, not volume, thus compensating for variations due to changes in specific gravity, bulking or size of material. The feeder is quite accurate, and it affords automatic feed control for crushers, pulverizers, mixers, dryers, kilns, furnaces and conveyors. The feeder is bin-supported, requires little headroom. Bulletin 33-E-1.



Constant-Weight Feeder

The Hardinge Disc Feeder is outstanding in its simplicity, sturdiness and ease in adjustment. Particularly suitable for handling bulky, sticky, hot materials. Bulletin 33-E-1.



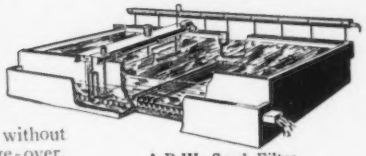
Disc Feeder

HARDINGE COMPANY, INCORPORATED

YORK, PENNSYLVANIA

NEW YORK • TORONTO • CHICAGO • HIBBING • HOUSTON • SALT LAKE CITY • SAN FRANCISCO • LAKELAND • BIRMINGHAM

FILTERING



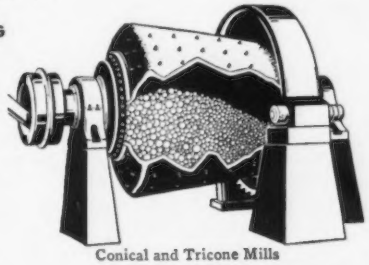
A.B.W. Sand Filter

The Hardinge Automatic Backwash Rapid Sand Filter cleans its own filter bed, a section at a time, automatically, without shut-down or change-over. Primarily adapted to the filtering of water containing small amounts of suspended particles that cannot be properly collected in settling basins or clarifiers. Used for filtering municipal water supplies, industrial water supplies, and certain presettled industrial waste waters to permit their re-use. Bulletin 46-A-1.

GRINDING—PULVERIZING

Conical Mills®

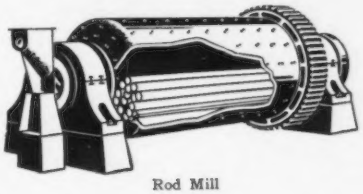
The shape of the Hardinge Conical Mill causes a rapid circulating and classifiying action within the drum, maintaining the large balls at the feed end of the mill for maximum grinding efficiency. Dry grinding applications — Bulletin 17-C-1; Wet grinding—Bulletin AH-389-1.



Conical and Tricone Mills

Tricone Mills

Built on the same principle as the Conical Mill, the Tricone Mill offers greater grinding volume for a given amount of floor space than any other tumbling mill built. Extremely efficient. Ideal for large tonnages. Sizes up to 12 ft. diameter. Bulletin AH-414-1.



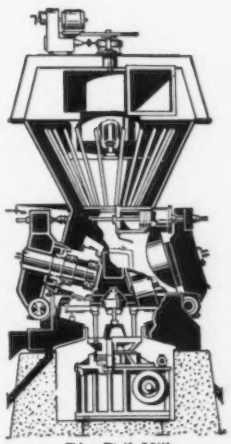
Rod Mill

Rod Mills

Steel rods are employed as grinding media. Ideal for producing minimum oversize in open circuit grinding. Conical heads reduce friction, prevent congestion of charge at the ends, and align the rods. Available with either end, or center, peripheral discharge, as well as trunnion over-flow. Bulletin 25-C-1.

Disc Roll Mills

An adaption of the German "Loesche Mill." A roller-mill with rotating grinding table and pneumatically-loaded rolls for complete flexibility of operation. The "Gyrotor" Classifier, combined with the Disc Roll Mill, provides a highly-efficient dry-grinding device ideal for relatively soft minerals. Bulletin 52-1.



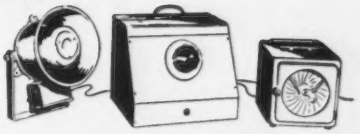
Disc-Roll Mill and "Gyrotor" Classifier

Cascade® Mills

A continuous mill using the autogenous grinding principle—large pieces of material grinding the smaller ones. Shape of the mill causes maximum "free fall" and impact. Feed is divided into coarse and fine components and re-combined in proper proportion for best grinding.

Cascade® Mill

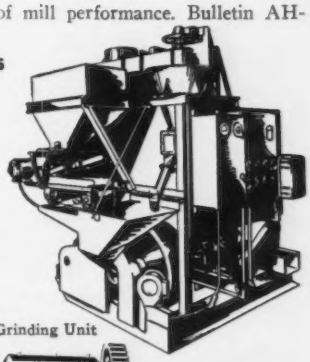
GRINDING SOUND RECORDER



Portable Sound Recorder

The Hardinge Portable Sound Recorder can be used in checking the efficiency of grinding mill operation. It may also supplement existing "Electric Ear" installations by maintaining an "around-the-clock" record of mill performance. Bulletin AH-480-1.

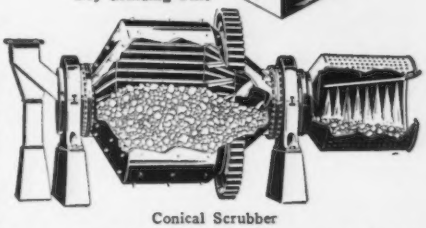
LABORATORY GRINDING UNITS



Dry Grinding Unit

For any small-scale continuous grinding operation, either wet or dry, Hardinge offers a completely self-contained and portable unit which provides all the functions of feeding, grinding, and classifying found in a large-scale system. Complete controls and wiring provided. Just "plug it in." Bulletin AH-448-1.

SCRUBBING

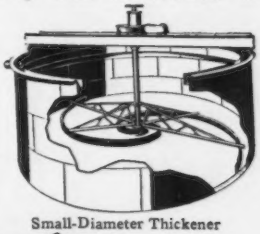


Conical Scrubber

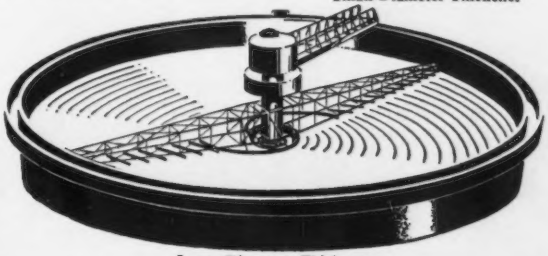
The Hardinge Conical Scrubber cleans by mass contact and natural displacement. This action removes dirt and silt without wear on the scrubber. The classifying action of the cone holds back the large clay balls until properly disintegrated. Foreign materials, such as sticks, vegetation or large pieces of metal, can do no harm. Power required is low, and water requirements are considerably less than that of other methods. Repair costs are negligible. Bulletin 37-B-1.

THICKENING

The distinctive features of the **Hardinge Thickener** are the spiral scrapers, which clean the bottom of the tank with each revolution, and the "Auto-Raise" driving mechanism which automatically lifts the scrapers away from an overload or obstruction in the tank bottom, thus eliminating costly breakdowns and delays. Can be operated very slowly, causing a minimum of disturbance. Produces a clearer overflow and a thicker discharge than other types. Small thickener mechanisms are supported on beams, spanning the tank. The large units carry the mechanisms on a central concrete pier. Bulletin 31-E-1.



Small-Diameter Thickener



Large-Diameter Thickener

LOCAL OFFICE PHONES: YORK, PENNA.—YORK 33-821; NEW YORK—OXford 7-3590; TORONTO—EMpire 3-5692; CHICAGO—FRanklin 2-4182; HIBBING, MINN.—AMhurst 2-2825; HOUSTON—JAckson 3-1733; SALT LAKE CITY—HUnter 4-5151; SAN FRANCISCO—YUkon 2-8862; LAKELAND, FLA.—MUtual 6-5135; BIRMINGHAM—ALpine 1-9262.

Nevada *(Continued)*

ton trucks, 2½ yd diesel shovel and using prilled ammonium nitrate as a blasting agent. Since the deposits are very erratic, the pit benches are on 10 ft intervals and all cuttings from the drill holes are analyzed and a chemical contour map is made. Only in this way can the grade of ore be controlled.

Basic Inc. (formerly Basic Refractories Inc.) produces a wide range of furnace maintenance refractories, varying from pea size to powder. These ramming, gunning, patching and hearth maintenance materials protect the furnace structure from the extremely high temperature and corrosive action of the metal bath. Also produced at Gabbs from mined or beneficiated magnesite ores is Magox, a chemical magnesium oxide available in varying grades of purity from 91 to 97% MgO. This product has extensive application in industrial and chemical processing.

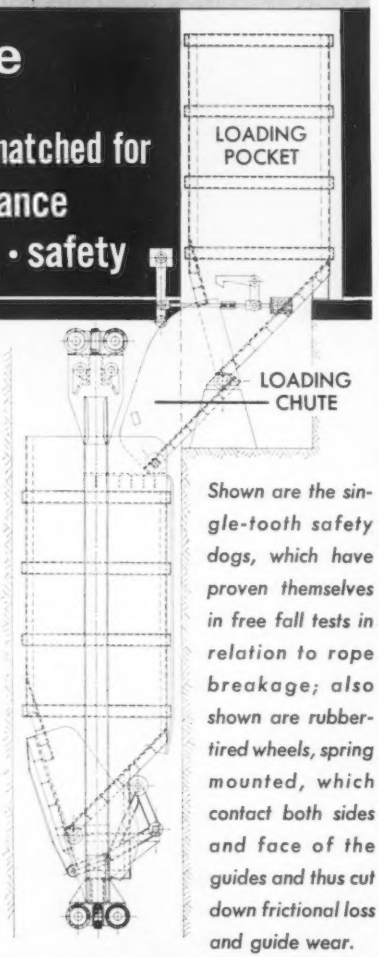
In March 1961 these companies and individuals owned claims in the magnesite area:

Basic Inc.
Standard Slag Co.
United States Brucite Co.
Frederick S. Thornton

The two principal operating companies are Basic and the Standard Slag.

from top to bottom...

Connellsville SKIPS are unmatched for
• efficiency • performance
• economy • durability • safety



A 42-year record of outstanding service in handling coal, salt, potash, soda ash, aggregate, limestone, zinc, and other minerals and ores has proven the Connellsville Bottom Discharge Skip.

Each Skip is custom-built to your requirements . . . the skips mechanically open the loading chutes; the skips are filled and in turn, the departing skip closes the loading chute, toggle locking. Since the skip is of the fixed hopper type, both the bail and the lateral construction of the skip aid in maintaining its shape and structure. Write for information today on how you can increase the efficiency of your hoisting operation.

Shown are the single-tooth safety dogs, which have proven themselves in free fall tests in relation to rope breakage; also shown are rubber-tired wheels, spring mounted, which contact both sides and face of the guides and thus cut down frictional loss and guide wear.

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NEW MEXICO

Susquehanna Corporation's metallurgical and chemical division currently is engaged in "a promising mineral exploration program" near Santa Fe, according to J. Patrick Lannan, chairman and president.

He said initial exploration has indicated the presence of substantial quantities of germanium metal as well as copper and uranium. Susquehanna has just started up a new uranium ore processing plant near Falls City, Tex.

Grant County mining picked up with the reopening of the Peru Mining Co.'s lead and zinc mine and its Deming mill.

The schedule calls for production of 500 tons per day with the milled ore to be shipped to Dumas, Tex.

NORTH CAROLINA

The State Board of Conservation and Development said that it is going to keep State Geologist Jasper L. Stuckey on the job although he has passed the retirement age of 65.

State C&D Director Hargrove Bowles said Stuckey "knows more about geology in North Carolina than any two or three men" and is too valuable to lose at this time.

Since he has passed his 65th birthday, Dr. Stuckey would retire automatically on June 30 unless the State Retirement Board agrees to extend his retirement date. Customarily such a request is honored.

Consolidated Mica Co. of Asheville, has been licensed by the TVA to use its process for the wet-grinding of mica to produce a light material of high sheen and good color for use in paints and pigments.

Upon recommendation of its Mineral Resources Committee, the North Carolina State Board of Conservation and Development approved leasing of additional swampland in southeastern North Carolina to Roderick A. Stamey of Houston, Tex., who already holds oil, gas and sulphur mining rights to state-owned river and creek bottoms in that area.

The swamplands belong to the State Board of Education since they are without established private owners and have been held in the name of the board since provisions to that effect were included in a new state constitution adopted in 1886. Stamey's request for a lease recently was held up by Governor Terry Sanford and the Council of State until the State C&D Board could express an opinion.

Under Stamey's lease on the river bottoms, he has been required to drill at least 12,000 ft every two years to get it renewed. However, the amount of drilling he will have to do to get his leases renewed now has been increased by 8,000 ft to a total of 20,000 since the swampland gives him additional acreage. This was done at the request of the Council of State.

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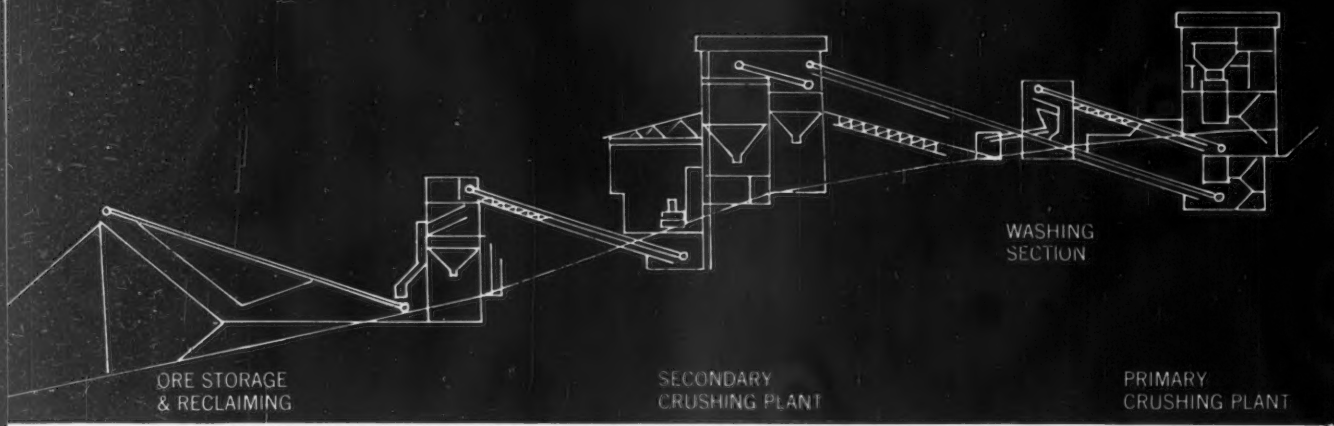


Simplified diagram shows principal operations at the new El Encino open pit iron mine near Colima, Mexico

New Open Pit Iron Mine in Mexico

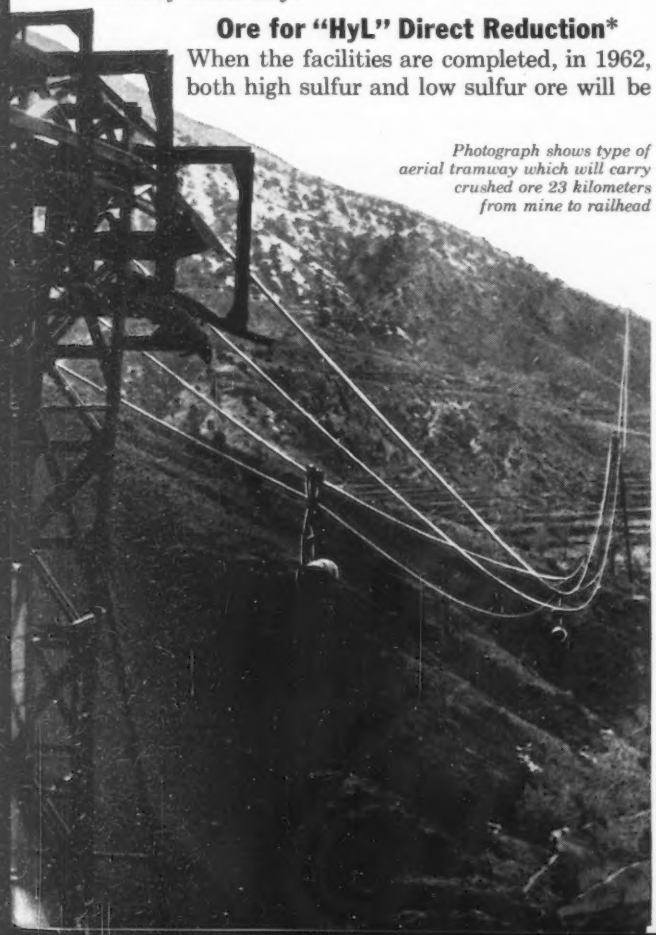
—NEW ENGINEERING/CONSTRUCTION JOB FOR KELLOGG

An important step forward in Mexico's steel producing expansion program will be the new El Encino open pit iron mine and 340 metric ton/hour crushing plant, near Colima, of Empresas Industriales, S.A., Monterrey.

The Kellogg organization has undertaken over-all responsibility in connection with the engineering and construction for this entire project. Construction is already underway.

Ore for "HyL" Direct Reduction*

When the facilities are completed, in 1962, both high sulfur and low sulfur ore will be transported separately by aerial tramway 23 kilometers cross-country to the railhead—and from there to Monterrey. Here, the ores will be reduced to sponge iron by the HyL direct reduction process, using reformed natural gas as the reducing agent.



Photograph shows type of aerial tramway which will carry crushed ore 23 kilometers from mine to railhead

Kellogg's Complete Assignment

Kellogg's responsibility includes the pit, pit road to the crushing plant, crushing plant and auxiliaries, access road to the State highway, tramway, and railroad storage and loading facilities which include over 3 kilometers of track.

Ore Flow from Pit to Sky

In the pit, 3-yard diesel shovels will load 38-ton trailer trucks to carry the ore 3 kilometers down the mountain to the crushing plant. Here, a primary 48" x 60" jaw crusher will reduce the ore to minus 6". After washing and hand picking, a secondary crusher will reduce the ore to minus 2"—proper size for HyL reduction. From segregated storage piles, ores will be conveyed by belt to the aerial tramway buckets.

Many Auxiliary Assignments

Auxiliaries also being undertaken by Kellogg include two diesel electric power stations—600 KW at the loading yard, and 1400 KW at the plant site, all necessary buildings and maintenance facilities, and development of the water supply.

Kellogg welcomes the opportunity to tell you more about this project and its work in engineering and building ore reduction plants.

**The M. W. Kellogg Company is exclusive world-wide licensing agent for the HyL Direct Reduction Process.*

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KELLOGG

OREGON

Kerr-McGee Oil Industries, Inc., through subsidiary Kermac Nuclear Fuels Corp., has acquired Lakeview Mining Co. and Gunnison Mining Co.

Acquisition was through an exchange of stock in Kermac with owners of Gunnison and subsidiary Lakeview Mining. The firms were controlled by the Murchison, Richards and Bass interests of Dallas and Fort Worth, Tex.

Lakeview owns a solvent-extraction-process uranium mill at Lakeview, Ore., which has been closed since Oct. 1960 because of an ore shortage in the area. The mill, which cost $2,025,000 has a contract with the AEC running to Nov. 30, 1963. From July 1, 1960, to April 1, 1962, Lakeview may sell 805,000 lb of U308 to AEC at $9.27 a lb. Post-1962 deliveries in the range of 766,600 lb will be at rate of $8 a lb. Remaining contract forward from July 1, 1960 totaled $13,600,000 lb. Lakeview, with a 250-tpd mill, recently obtained a freight rate on uranium ore from Wyoming's Shirley Basin fields to Lakeview.

Gunnision Mining Co., with a 200-tpd solvent extraction plant at Gunnision, Colo., has a contract with the AEC to Dec. 31, 1962, for 823,000 lb of U308 to be delivered between July 1, 1960, to July 1, 1962, at $9.19 a lb and 205,800 lb at $8 a lb for delivery between July 1, 1962 and Dec. 31, 1962. Remaining contracts are $9,200,000, forward from July 1, 1960.

Spokesmen for Kermac Nuclear said that Lakeview operations would be conducted in the name of the Lakeview division of Gunnision Mining Co., with J. L. Robinson continuing as general manager.

D. A. McGee, president of Kerr McGee Oil Industries, Inc, said that the "Lakeview-Gunnision acquisitions are a part of a company plan to diversify and expand operations in the minerals industry by acquiring strategically located chemical processing facilities."

He said both Lakeview and Gunnision had plants which "can be used for treating and concentrating raw materials other than uranium and are favorably located for this purpose."

He said that Kermac was launching an exploration search in the area of these plants for minerals which could be utilized as feed materials in the solvent extraction process.

Successful melting and casting of 100% pure tungsten, the metal with the highest melting point of all known elements, was announced by Oregon Metallurgical Corp., in reporting the results of two years of intensive development work with alloys of the metal.

Stephen M. Shelton, president of Oremet, described the accomplishment as vital to the nation's progress in meeting metallurgy requirements related to U. S. space exploration.

Shelton, who headed the U. S. Bureau of Mines' Northwest Electro-Metallurgical Laboratory before organizing Oremet in 1955, said the attainment of 100%

FRESH WATER

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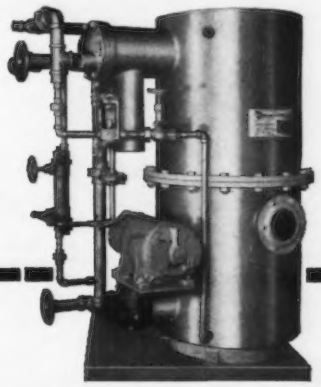

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For further details write Dept. M for the new illustrated Aquavap Bulletin.

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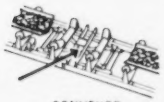
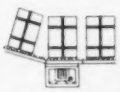


CONVEYOR SCALE SYSTEM

CONSTANT-FEED WEIGH-HOPPER SYSTEMS



CHECK-WEIGHING SYSTEMS

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Weighing & Controls, Inc.

Subsidiary of **CompuDyne Corporation**

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Oregon *(Continued)*

tungsten castings also would help reduce the production cost of tungsten metal parts.

The melting point of tungsten is 6170° F, Shelton explained, but the temperature of the metal at the time of the pour for the castings made inside an electric arc vacuum furnace is not known.

TENNESSEE

New Jersey Zinc Company announced closure of the Flat Gap zinc mine on the 28th of April. The large underground mine had been producing about 25,000 tons of zinc concentrates annually. Company officials said the present state of the zinc market and the low prices prevailing have forced it to cut back smelter production drastically at their Palmerton, Pa. smelter, which normally processes zinc concentrates produced at Flat Gap. J. I. Craig, superintendent at Flat Gap, said that all of the 138 hourly production and maintenance workers were laid off.

During the unusually wet spring in Tennessee, New Jersey Zinc had approximately 10,000 tons of clay enter their Treadway underground zinc mine along an oxidized fault plane. The mine is in the Knox dolomite which produces clay-filled seams along weathered fault zones.

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UTAH

New Park Mining Co. proposed construction of a 200-tpd mill underground at its Park City district lead-silver-zinc properties, according to W.H.H. Cranmer, president.

Tailings would be returned to fill in mined out stopes, Mr. Cranmer said in annual report to shareholders.

The firm presently ships its ores to Midvale mill of United States Smelting Refining & Mining Co. south of Salt Lake City.

"Our Defense Minerals Exploration Administration project enables us to open up large bodies of new ore. Together with that already blocked out in the stopes, we shall have ample mill feed," he said.

Elsewhere in the report, Gale A. Hansen, general superintendent, said that reserves of ore had been increased 26% as a result of exploration and development.

In this work, the "Pearl fissure was intersected at the 2005-ft level. "The structure at this point is very strong and indicates a substantial Pearl ore reserve," said Mr. Hansen. "This fissure continues to produce more than an ounce of gold per ton and gold-silver-copper content of the fissure is expected to continue with additional depth. Deep level exploration on the 2005-ft level has just entered the top of the Madison limestone formation and this project is within 1500 feet of the target area.

"Through detailed mapping and geological interpretation our geologists have been able to locate several high-grade orebodies on the 2005-ft level," Mr. Hansen said.

"These orebodies are now being developed and prepared for mining," he added.

Mr. Cranmer predicted that eventually, the limestones in the Park City district would produce as much, if not more, in values than the Weber quartzite. More than half a billion dollars in values have come from the Weber section.

New Park Mining Co. has also started an experimental tree ranch at Hailstone, Wasatch County.

The move is in the direction of broadening diversification of the mining firm and placing properties in use. Some 50,000 seedlings—firs, cedars, pines—have been placed out in three separate tracts covering 72 acres.

One 32-acre tract will be cultivated and sprinkled by overhead irrigation; a second 15 acres will see the seedlings planted in shade of sage brush. It, too, will be irrigated by overhead sprinkling. A third tract of ten acres will see the trees placed in the protection of the sagebrush. But there will be no irrigation. New Park executive vice president Robert L. Cranmer figures it will take two years before New Park can assess growth and economics.

The firm aims at lumber and Christmas tree business. It would take an estimated ten years to grow cutable timber from the tracts under optimum conditions. New Park also has established a nursery for production of its own seedlings for added plantings.

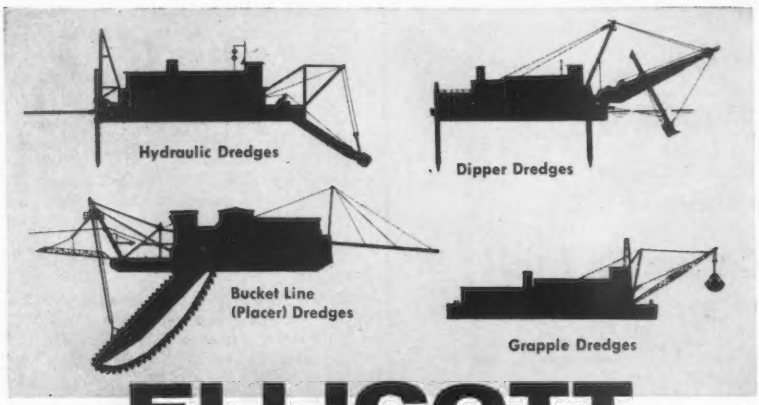
Hidden Splendor Mining Co., one of the nation's largest uranium mining firms, had net profits for 1960 of $1,252,622 after depreciation, depletion and amortization.

The firm is an affiliate of Atlas Corp. and is Atlas's main holding.

Hidden Splendor president, A. P. Kibbe, Salt Lake City, said 1960 net cannot be compared with any previous figure, as Hidden Splendor was put together in October of 1959 through merger of five firms.

The firm's cash flow was $7,207,205 last year while gross revenues were $17,488,081. All but about $100,000 of the net profits came directly from uranium mining activities in Utah, Wyoming and New Mexico. Mr. Kibbe said that major tonnages in the Utah, Big Indian District, came from North Almar, Ike-Nixon and Columbia claims, adding that "in recent months, two high grade mines — the Louise and the South Almar — have been brought into production."

"Because ore reserves in the Dysart No. 1 were less than previously estimated and because of heavy ground," this New Mexico mine is being closed, he said. An "important achievement" during



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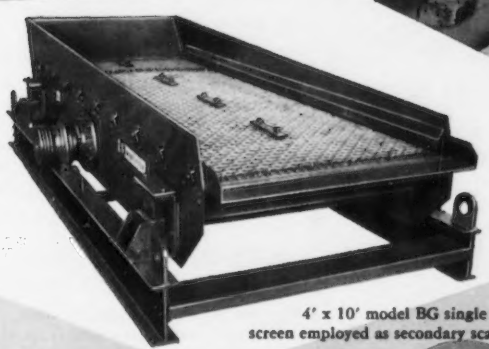
At right is the Simplicity Scalper and Picking Table in production at Big Chief Mine. After leaving the 42" x 12' Simplicity vibrating feeder, the run-of-mine material is carried by belt to a 5' x 7' feeder. At the primary scalper, plus 5" block is fed off the top deck and onto the picking table shown in this photo. • Once the slate is removed, block coal is conveyed to railroad cars. 5" x 0" material passing through the openings of the scalper deck is received by a 4' x 10' secondary scalper, where 1¼" x 0" material is screened and fed to a bank of three 5' x 10' single-deck gyrating screens. ⅜" x 0" carbon coal is screened and conveyed to railroad cars. Plus ⅜" to 1¼" coal retained by the decks of the three sizing screens and plus 1¼" x 5" material from the secondary scalper forms the main flow. This material is washed, dewatered, crushed and sized prior to loading in railroad cars.



4' x 10' model BG single deck screen employed as secondary scalper.

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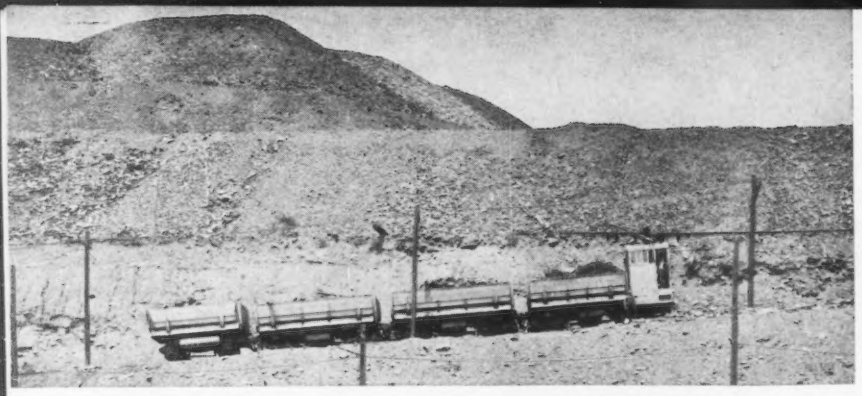

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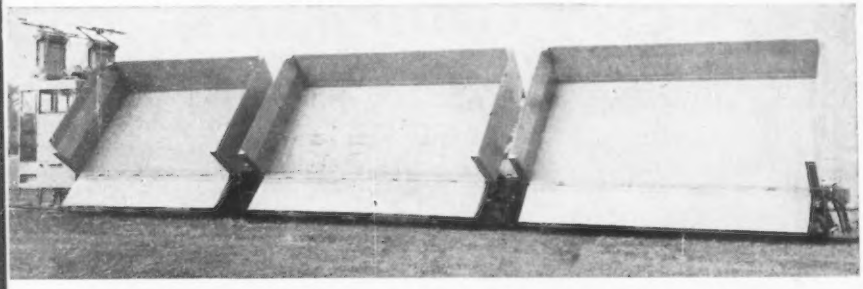

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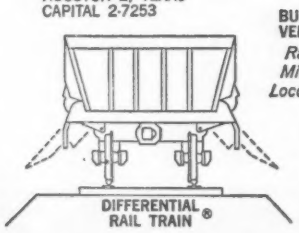

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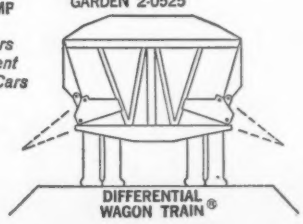

Rent Differential WAGON TRAINS from DIFCO, Findlay, Ohio

Utah *(Continued)*

1960 was the start of production at the Sunset open pit mine in Wyoming's Gas Hills district, Mr. Kibbe commented in his annual report to shareholders.

Delhi-Taylor Oil Corp. intends to continue its activity in minerals developments in the western states.

Dr. Elton Soltes, general manager of special projects for the Dallas, Tex. oil firm, said that the firm has "developed an experienced minerals group" and will search for "strategic minerals, including beryllium" and gold.

"Through its pioneering efforts, Delhi succeeded in establishing a potash industry in Utah, a new source of this material for the country and a substantial interest for Delhi in the largest high grade potash deposit in the United States, "Dr. Soltes told the recent annual meeting of Delhi Taylor shareholders. Texas Gulf Sulphur Co. is currently putting the Cane Creek potash properties into production.

Thomas Bardon, New York City, president of Shattuck Denn Mining Co., has been elected a member of the board of directors and of the executive committee of Chief Consolidated Mining Co.

His election reflects acquisition by Shattuck Denn of 479,000 shares of preferred stock of the Chief, said Cecil Fitch, Jr., Eureka, Utah, president of the mining firm.

The 479,000 shares represent 17.1% of all outstanding stock in the Chief (including both common and preferred). Shattuck also becomes, by far, the largest single shareholder in the Chief Consolidated Mining Co. The Chief is a member of the Tintic Unit under which Kennecott Copper Corp. is developing a large, high grade lead-silver-zinc deposit in the Tintic District. Most of the discoveries to date have been on Chief ground. Mr. Bardon fills the unexpired term on the Chief board held by Harry J. Pitts, former chief engineer of the Utah mining firm, now living in retirement in Navato, Calif.

VIRGINIA

U. S. Gypsum Co. has started development of their large underground gypsum mine, located 18 miles from Saltville. Transloaders, made by the Sanford-Day Co. of Knoxville, Tennessee, will be used to muck and transport the "ore".

WASHINGTON

An initial shipment of 15 tons of lead concentrate has been made from the new gravity-type mill at Leadpoint, operated by Clayloon Uranium Co. Concentrate was shipped to a Kellogg, Idaho, smelter. Officials said about 125 tpd of ore is being milled. The mill has been using stockpiled ore but open pit mining at the firm's Lead Trust property will be resumed by the middle of May.

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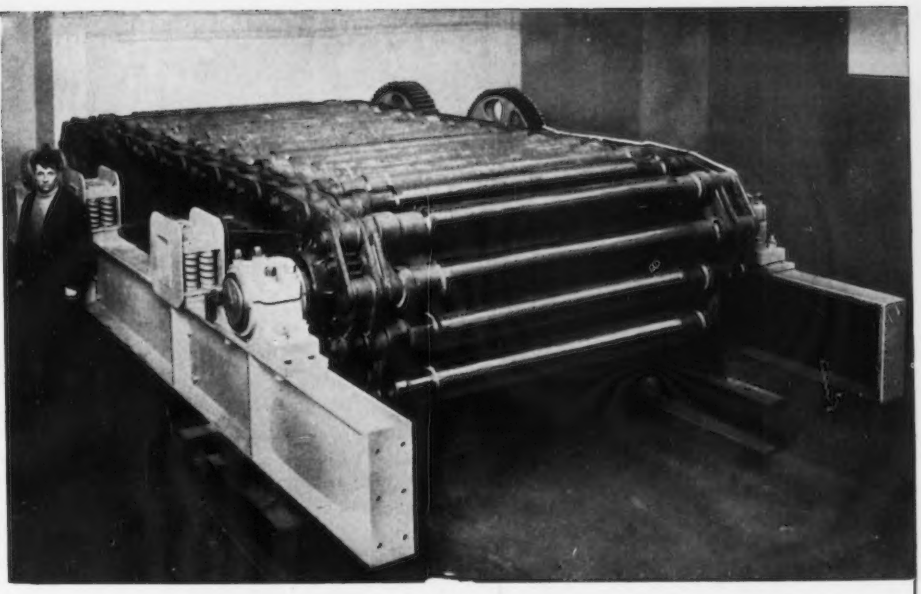

Photograph shows a No. 10 Ross Patent Drop-Bar Feeder assembled before despatch to Llanddulas Quarries for feeding a 60" x 42" Jaw Crusher. The photograph illustrates the very heavy construction of the apron, in this case 7" dia. steel bars at 10" centres and the heavy shock-absorbing coil springs which support the apron.

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PROGRESS REPORT: ATLANTIC CITY PROJECT

Dings Magnetic Separators to serve Multi-million dollar Wyoming Taconite Project for Columbia-Geneva

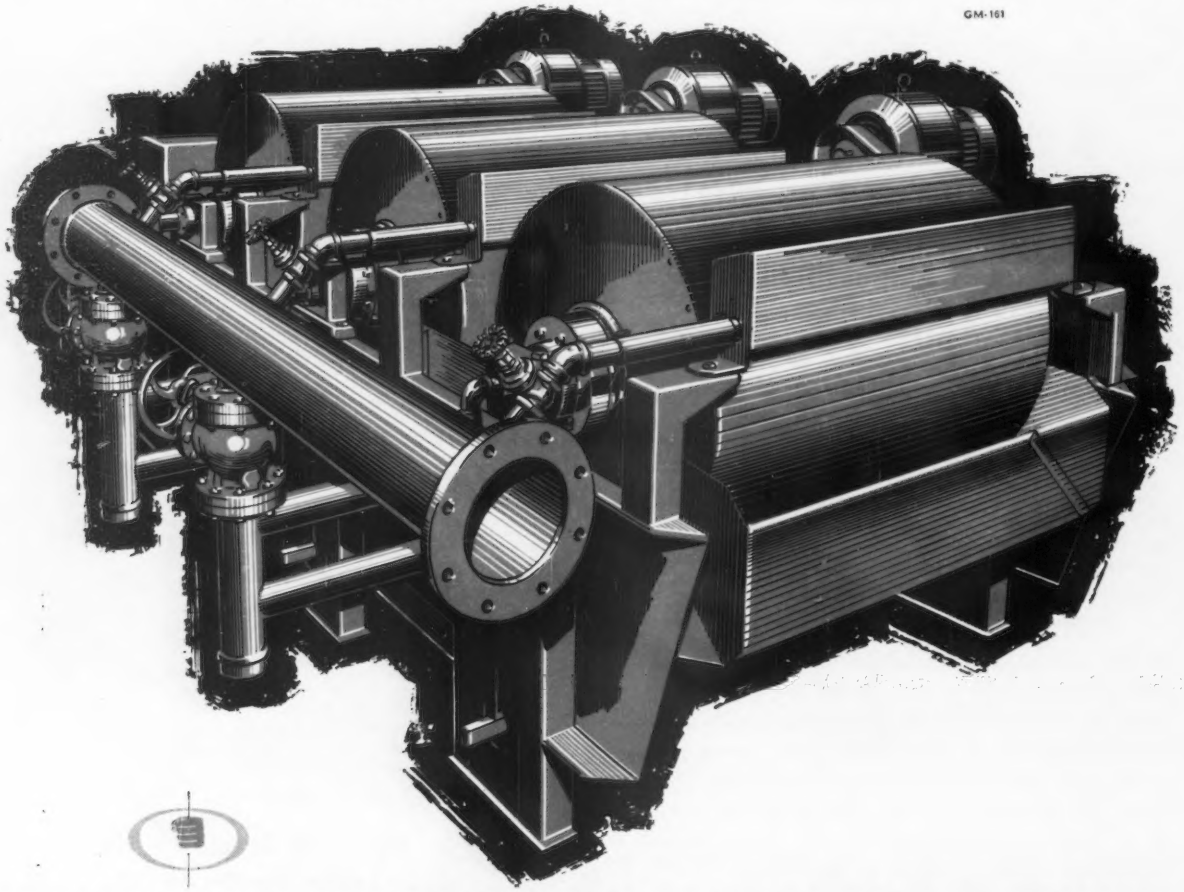
108 Dings Electromagnetic Drums of an improved design will serve the important magnetic separation processes for Columbia-Geneva's new high-grade taconite beneficiation facility.

Cooperation—between Dings and Columbia-Geneva technical personnel in working out specific equipment requirements to best serve this operation—has resulted in magnetic separation equipment designed to provide high recovery efficiencies . . . with a minimum of operational attention.

Here, as elsewhere, Dings' long history of experience in the field of magnetic separation has been put to work to help further improve the economic future of low-grade iron ore processing.

The Atlantic City Project will utilize 108 Dings Electromagnetic Drums for the cobbing, roughing operations and finished recovery of the taconite ore. Designed for continuous service, these advanced type separators will utilize expendable liners at wear points for ease of maintenance. Electro-type drums permit varying of the intensity of the magnetic field for desired metallurgy.

GM-161



DINGS MAGNETIC SEPARATOR COMPANY ■ MILWAUKEE 46, WISCONSIN

Washington *(Continued)*

Ore-Bee Mills, Inc., Yakima, Wash., manufacturers of a new mining mill that its producers claim will revitalize the small mining industry, have named an Anaconda, Mont, firm as its Montana dealer.

Lombarti Bros., 120 W. Front St. Anaconda, Montana and Idaho silver and lead mine operators, are demonstrating the 3,000-pound portable unit.

"In the three weeks we have had the mill in Anaconda," Art Lombarti said, "there have been at least 100 inquiries about it."

The brothers said they plan to use the one-man machine in their own lead and silver mines near Salmon, Idaho. They also operate silver and silica mines at Bannock, Mont.

Goldfield Consolidated Mines Co., San Francisco, has taken over the exploration of Triton Mining Co.'s Little Joe and Galena Knob mines near Colville, under an agreement which provides a 60-day option to acquire control. Goldfield Consolidated officials said work is running on a round-the-clock basis.

Triton Mining Co. has been doing exploration work at the two properties in the Joe Creek area about 10 miles north of Colville. Work was started last year, and extension of an old tunnel has disclosed some high grade zinc-lead ore.

Goldfield also has been working on a development program at its Anderson zinc mine near Deep Lake in the Colville area.

Pend Oreille Mines and Metals Co. reported a 1960 net income of $30,358 compared with a net loss of $7833 in 1959. The Spokane firm said that output at the Pend Oreille mine near Metaline Falls totaled 727,759 tons of ore compared with 619,779 tons the year before. Operating costs were reduced to $3.004 per ton from $3.116 in 1959. President Jens Jensen said the current low prices for lead and zinc have kept profits down.

A reorganization-recapitulation plan was approved by shareholders of Metaline Contact Mines at a meeting in Spokane May 5. The plan involves acquiring contiguous properties of Bunker Hill Co. and Day Mines, Inc., in the Metaline mining district of Northeastern Washington. Bunker Hill, of Kellogg, Idaho, and Day Mines, of Wallace, Idaho, are the principal stockholders of Metaline Contact. Under the consolidation plan, Metaline Contact will own a large number of mining claims in the Metaline district.

New directors elected are Charles E. Schwab, Bunker Hill president, and Robert E. Brown, Kellogg, Idaho, attorney. Reelected to the Metaline Contact board were L. J. Randall, Wallace, president of Lucky Friday Silver-Lead Mines Co. and of Hecla Mining Co., and F. W. Rothrock and Wray D. Farmin, both of Spokane, vice presidents of Day Mines.

Schwab was elected president of the firm. Farmin was named vice president and R. C. Lyons, Kellogg, was named secretary-treasurer.

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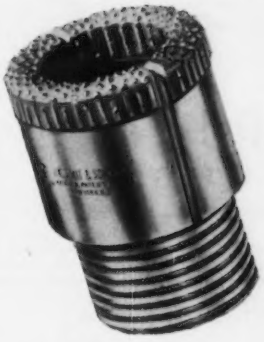

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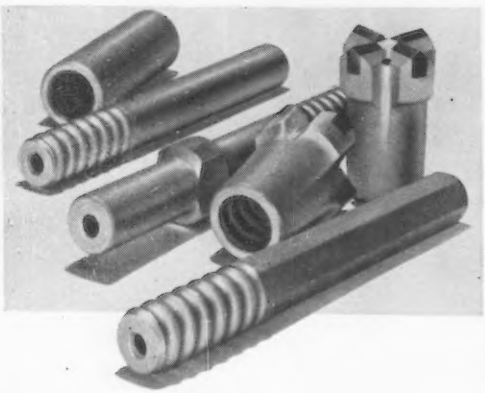

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WISCONSIN

The Oliver Mining Co. was granted permission by the Iron County Board of Supervisors to conduct drilling tests on county owned land in the Town of Anderson, aimed at possible establishment of a taconite plant in the area.

WYOMING

C. J. Paustian of Wyoming Bentonite Co., Greybull, was elected president of the Wyoming Mining Association at its sixth annual convention.

A. W. Runge, Riverton was elected vice president and Morton E. Pratt, Riverton, was named secretary-treasurer. Runge is head of Susquehanna-Western's ore procurement division and Pratt is general manager of the Lucky Mc division of Utah Construction and Mining Co.

Re-elected to the board of directors were Paustian; Myron L. Sisson, general manager of Colorado Fuel & Iron Co. operations at Sunrise; and V. O. Murray, general manager of the Union Pacific Coal Co., Rock Springs.

Newly elected directors are W. I. Leonard of Idealite (cement) Co., Laramie; Elton Clark of Green Mountain Uranium Co., Lander, and Jack Mullinax of Mullinax Sand and Gravel Co., Sheridan.

A. V. Quine, former general manager of Lucky Mc, resigned from the board of directors and Pratt was named to fill out the remaining year of his term.

The retiring directors are Roy Coulson, Riverton, Vitro Minerals, the association president; H. E. Potter, Monolith Portland Midwest, Laramie, and O. F. Tucker, Casper, sand and gravel.

The association went on record favoring a thorough revision of the state's unemployment compensation laws and adopted a resolution opposing further Federal regulations or control of the unemployment compensation program.

The association said Wyoming unemployment laws should be amended to keep the cost of the program at a reasonable level and to utilize the fund for

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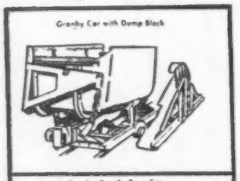

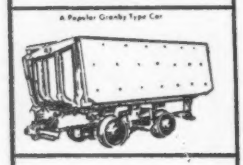

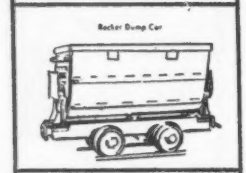

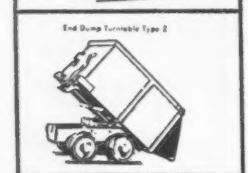

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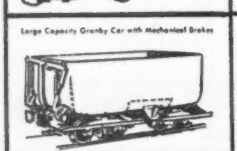

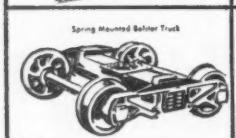

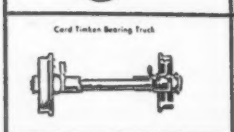

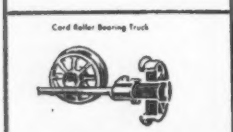

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Wyoming *(Continued)*

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The 1961 Wyoming legislature passed a bill to limit to $47 the maximum allowable weekly benefit and tighten qualifications for unemployment compensation claimants. It was vetoed by acting Gov. Jack Gage.

R. W. Beamer, the association's executive secretary, said the unemployment compensation fund is being rapidly depleted through too liberal payments.

The association also asked the Atomic Energy Commission to give a greater degree of flexibility in fulfilling of uranium ore allotments. The association said a producer should be able to transfer part of his allocation to another mine if his original mine is depleted.

In other resolutions the association:

1. Opposed any Federal legislation that would abridge the state's jurisdiction in mine safety legislation.

2. Encouraged growth of electric industry under private enterprise system and opposed construction of "uneconomic tax-free hydroelectric plants with Government funds." The proposed Burns Creek project in Eastern Idaho was not specifically mentioned by name but the Association officials testified against the project in a recent Congressional hearing. They contended that the Burns Creek power project would cut the demand for coal in the Kemmerer area which can be utilized for steam power plants.

3. Opposed extensive withdrawal of public lands for any particular purpose, especially proposed wilderness legislation.

4. Urged preservation of the present system of mining law for locating patented mining claims.

5. Urged return of 90% of royalties from Federally-owned land to the states.

6. Urged an adequate national mineral research program with ample appropriations for the U.S. Geological Survey.

R. W. Beamer, executive secretary of the Wyoming Mining Association, predicts that mining will soon become Wyoming's second largest industry — behind the oil business.

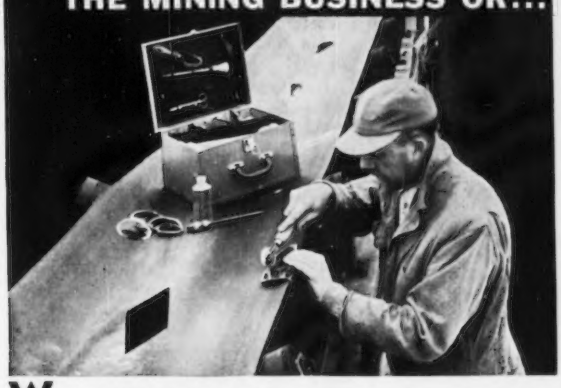
Beamer said the gross product of Wyoming's mining industry more than doubled in the past five years and in 1960 more than $100-million in minerals was produced.

Beamer predicted that within two or three years, mining's gross product would equal agriculture which now has a gross product of between $140- and $150-million a year.

Congressional action would be needed before Vipont Mining Co. could build a gypsum mine and plant on the Wind River Indian reservation, Vipont president Alfred Ellerby said.

Former Sen. Joseph C. O'Mahoney, representing Vipont, said the Interior Department may recommend some method to permit development of natural resources on Indian reservations.

HOW TO SAVE MONEY IN THE MINING BUSINESS OR...



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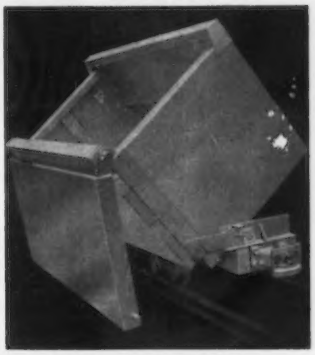

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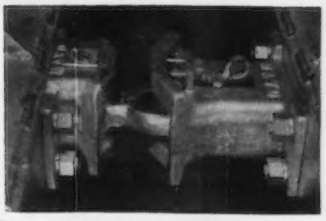

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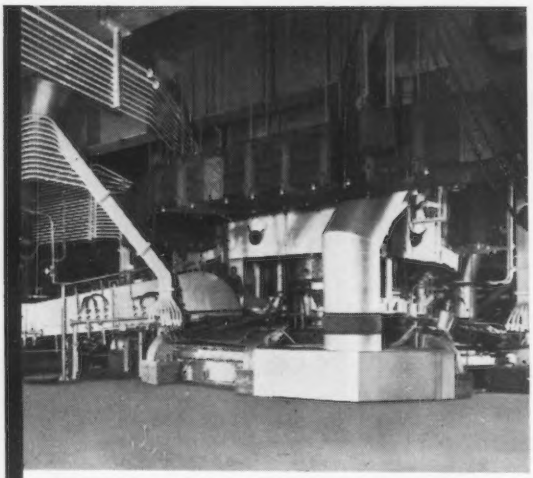

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Wyoming *(Continued)*

Ellerby said he hopes Congress would pass a trial bill for the proposed gypsum development on the reservation.

He said the firm would employ the Shoshone and Arapahoe Indians on the reservation and they would also receive a royalty on the gypsum mined there.

Ellerby has proposed that the gypsum be mined and then processed at a plant in Shoshoni. The processed gypsum would then be shipped to Seattle for conversion into wallboard.

Ellerby said more than a billion tons of gypsum could be mined with very little overburden. Total reserves on the reservation are estimated at 5-billion tons.

IN CANADA

BRITISH COLUMBIA

In early May, the Japanese government approved the participation of Sumitomo Metals Mining Co. and Sumitomo Trading Co. in a $7.7-million copper development agreement with Bethlehem Copper Corp., Ltd., of Vancouver.

The 10-year contract with Bethlehem Copper calls for investment of $5-million by Sumitomo to develop the Highland Valley copper property. The loan will be paid off with delivery of concentrates at the rate of $50 per ton. Bethlehem, with some 20-million tons of copper reserves, also noted that the contract could be renewed. Output of 3000 tpd is planned for the first four years of the agreement and 5000 tpd thereafter, all going to Japan.

The Wall Street Journal points out that the new contract brings the total of long-term contracts signed by Japanese interests and B.C. mining companies to more than $200-million.

Reeves MacDonald Mines, Ltd., Remac, has optioned a lead-zinc prospect adjoining the Sullivan mine at Kimberley, and the firm plans to start test drilling at the site. The Sullivan mine is operated by Consolidated Mining and Smelting Co. of Canada, Ltd.

Jens Jensen, Spokane, president of Reeves MacDonald, said the optioned land includes 110 Crown-granted mining claims of 50 acres each. He said airborne magnetometer surveying indicated five anomalies later confirmed by ground magnetometer work. Diamond drilling will start at the site as soon as snow conditions permit. It is at the 5600-ft elevation. The property was optioned from Western Exploration, Ltd. The option agreement provides that Reeves MacDonald would recover all exploration and development expenses from production and after that would receive 70% of the net proceeds, with 30% going to Western Exploration.

Canada Tungsten Mining Corp. has arranged financing and expects to have its Northwest Territories property in production by the fall of 1962, according

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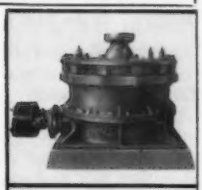

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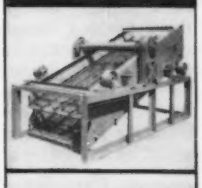

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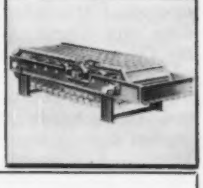

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to president Karl Springer of Spokane.

Present reserves would give the mine a life of 10 to 12 years. About $6-million in financing is available.

Northwest Amax Ltd., a subsidiary of American Metal Climax Inc., will develop the property and earn a 35% interest. Climax vice-presidents Wallace MacGregor and John Payne, Jr. are joining the Canada Tungsten board.

Concentrates from the open-pit mine will be trucked 180 miles to Watson Lake, thence to Whitehorse and Skagway where they will be shipped south. Plans call for a flotation mill with initial capacity of 300 tpd but grinding equipment will be adequate for 500 tons and provision is being made for further expansion.

Cariboo Gold Quartz Mining Co. Ltd. hit the Mosquito Creek fault last month following two years of work since the location was geologically indicated. Dr. W. B. Burnett, president, said at the annual meeting that Cariboo Gold Quartz was in the best position ever and dividends were definitely in sight.

About a year ago, the Burnett fault, opening a new ore zone, was encountered in the drive to the Mosquito zone.

A slight decline in gold production was shown by Bralorne Pioneer Mines Ltd. in 1960, but lower production costs, less U.S. dollar discount and increase in investment revenue boosted net income.

"The production of gold was only slightly less than in the preceding fiscal period, dispite suspension of production at Pioneer late in the year," Franc R. Joubin, president, said in his annual report.

Net profit, before depletion for 1960 was $811,362 or 51¢ a share, compared with $486,224 or 30¢ a share the 13 months ended Dec. 31, 1959.

The report showed: tons milled, 203,645, previous, 223,868; ounces gold recovered, 141,086, previous, 143,113.

Revenue from production, including estimated emergency gold mining assistance; $4,856,849, previous, $5,094,-649.

A supplementary report for the first quarter of 1961 showed 38,833 tons milled and 25,607 oz of gold recovered.

Bralorne Pioneer has now optioned or acquired most of the mining properties in the Bridge River area including a 30-claim asbestos property in the area south of Vanderhoofe which caused an exciting staking rush last summer. Joubin described the claims as "highly speculative" but interesting in view of the report issued by the federal government's geological branch last year. They lie adjacent to claims held by Cassiar Asbestos.

In addition to reporting encouraging development on Bralorne's 79 vein on the 38th level, Joubin said the company will carry on an active program in the west and in Eastern Canada.

He described the Ace-Congress property in the Bridge River area as one of the finest antimony prospects in Canada. The gold is worth only $6 or $7 a ton but there are between 600,000 and 700,000 tons of antimony ore. Bralorne

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Model DA-4; Weight 79 lbs., Height 21″, Length 16¼″, Width 16¼″.

Model DDV-2; Weight 79 lbs., Height 21″, Width 18″.

Pumping out settling sump in upper Canada mine. Shows air hose and water hose mixing settled mud into pumpable slurry. About 40 tons of mud filling 60-75 one ton cars per eight hour shift.

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The Nagle "CWO-CS" is "tailor made" for this application, because there are no bearings below the floor plate or near the pumped solution, and there is no rubbing contact between revolving and stationary parts below the radial bearing. All bearings sealed against contaminants. Seal problems entirely avoided. Send for Nagle Pump Selector—describes the complete line of Nagle Pumps.

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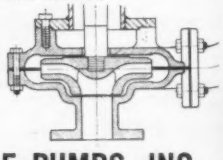
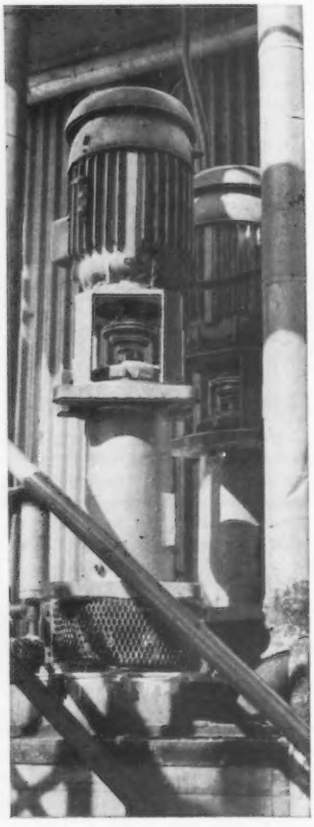


Center split casing—two halves bolt together. Bottom entrance arrangement eliminates trouble from solids settling and clogging. Truly a pump for tough pumping jobs.



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B. C. *(Continued)*

researchers are working on the problem of separating gold from the antimony.

At year's end Bralorne had ore reserves of 525,000 tons grading 0.85% gold and Pioneer, 64,000 tons grading .46%.

Skeena Silver Mines Ltd. has acquired 30 claims including 26 in one group in the Craigmont-Torwest area and has obtained an underwriting and option agreement which puts an immediate $20,000 into its treasury. Arthur Lungley, president, said the financing is provided by Hall Securities acting for a group of interior and Vancouver businessmen. The company's consulting engineer Cecil Rutherford has gone to examine the claims. Skeena also has 20 claims in Highland Valley, and is negotiating for a further group of claims in the general area.

Torwest Resources Ltd. reported that hole No. 10 is in ore from 30 ft down to 94 ft. R. E. Renshaw, company engineer, expects the hole will continue in this zone for 300 to 400 ft.

Toluma Mining and Development Ltd. plans to install a used 125-ton milling plant on the Guichon Mine property near Nicola, following bulldozer stripping operations which disclosed impressive copper mineralization under light overburden. There are approximately 500,000 tons of ore at the site. The open pit mine would be about 400 ft above the mill site and blasted ore could be dropped to the mill down a 45° slope.

Granby Mining Co. has signed a contract with Sumitomo Shoji Kaisha Ltd., Tokyo, for 2-million tons of iron ore concentrates estimated to be worth in excess of $18-million. The contract is for five years and replaces the original 1-million ton deal negotiated with Sumitomo earlier. Ore reserves on the property have been placed at 3.5-million tons from which the 2-million tons of concentrates can be produced. Further diamond drilling is in progress.

Imperial Metals & Power Ltd. has acquired the Bill Group of claims, a beryllium property in Yellowknife retaining the consulting engineering and research organization of Chapman, Wood and Griswold of Albuquerque and Vancouver. The company has also acquired control of Columbia Explorations Ltd. which owns the B. E. group of claims. Surface sampling will be done this year.

Craigmont Mines Ltd. has been holding talks with American Smelting & Refining Co. and with Mitsubishi, Sumitomo and Nippon, three Japanese firms, regarding future sale of concentrates. The firm is now building a mill for the production stage at its copper property near Merritt. A decision was expected in May.

Mid-West Copper & Uranium Mines Ltd. reports its diamond-drill hole No. 1 in the Arch No. 17 mineral claim, one mile south of the Craigmont mine near Merritt, has been advanced at minus 60°

to a depth of 262 ft, where it has encountered a faulted zone and hematite and pyrite mineralization. Casing is being placed to extend the hole to a depth of at least 600 ft.

Canam Copper Co. Ltd. has resumed diamond drilling following a fire in April which destroyed the compressor house and forced underground work to stop.

At that time the drift on the low level at 4300 ft elevation had been extended for 220 ft along the east limb of the orebody and 120 ft along the west limb of the zone. Work on the east limb defined the 220 ft to date as averaging 1.25% copper across an average of 38 ft.

Canam is controlled by Mogul Mining Corp. of Toronto which underwrote a $3-million debenture in 1956 to bring the mine in production.

Consolidated Mining and Smelting Co. of Canada Ltd. is completing designs for a steel-making and rolling mill at Kimberley. W.S. Kirkpatrick, president, said at the annual meeting that the final phase of the studies, the economic evaluation of the project, is receiving careful analysis because of the large capital expenditures involved. Project is expected to cost in excess of $32-million.

Cominco net earnings for the first quarter of 1961 were down 11% from the corresponding period last year. No figures were given. Kirkpatrick said that although the volume of metal sales has been slightly higher, metal prices have not recovered fully from the sharp drop experienced in the later months of 1960.

Pacific Nickel Mines Ltd. will be sold or liquidated and the proceeds distributed to the shareholders. The company no longer owns or operates any mining property but it has negotiable assets of $1,919,000 and 1,900,000 shares outstanding.

Trojan Consolidated Mines Ltd. reports it will prove up more ore, then decide on the next stage of its program. At the annual meeting, president P. A. Cramond said there were 374,000 tons of proven ore and 351,000 tons indicated, with an average grade of 1.41% copper. Diamond drilling on the main orebody, an east ore zone and probably on an anomaly is recommended.

A new low in copper prices threatens Howe Sound Co.'s Britannia Mine with complete shutdown soon. Copper prices are lower now than when the mine was forced to close for 10 months in 1958. Labor problems are also a factor. Conciliation board recommended renewal of the existing agreement for a three-year period with certain other provisions. Negotiations are still proceeding.

Swift Copper Mines Ltd. has started preparations for re-opening the Queen Victoria copper mine seven miles from Nelson. It is expected sufficient tonnage can be developed to justify re-opening the Kenville mill on which the company has an option.

Toluma Mining & Development Co. Ltd. reports an exploration and development

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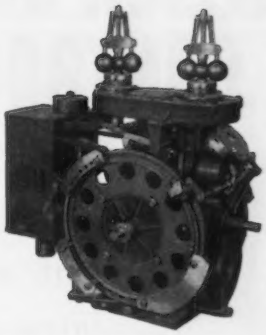

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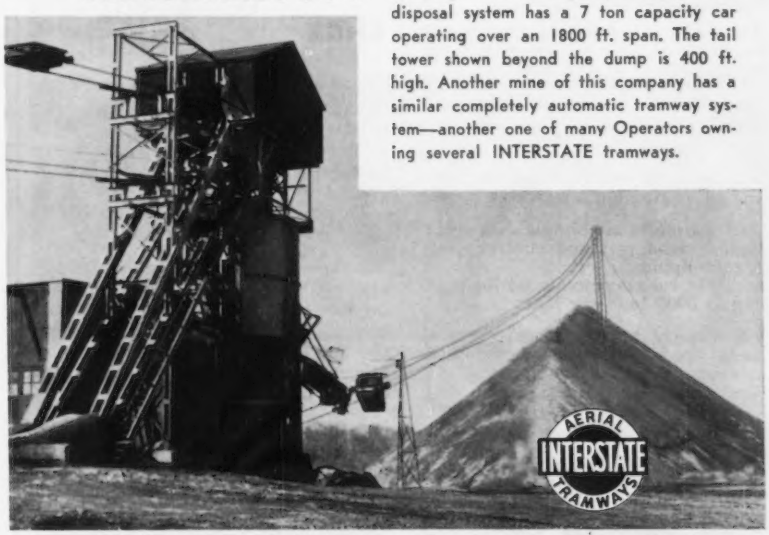

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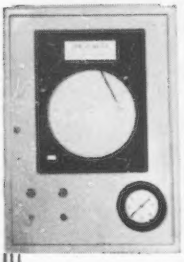

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B. C. *(Continued)*

program is planned for the Copperada property of Guichon Mine Ltd. involving an expenditure of between $100,000 and $150,000. Information has been gathered since September 1960 by geophysical work and stripping.

Noranda Exploration Ltd. has made the initial $10,000 payment to bind an option agreement, giving the company full ownership subject to a possible gross royalty on the Boss Mountain molybdenum property, 50 miles east of Williams Lake. A total of 35,000 ft of diamond drilling has been done and an area of mineralization outlined 1500 ft wide and 2000 ft long with two zones of economic interest.

IN LATIN AMERICA

COLOMBIA

The Ministry of Mines and Petroleum of Colombia has announced production figures for that nation for the year 1960. (Figures are in tons except where indicated otherwise.)

Sulphur	9,042	Lead conc.	1,300
Barite	7,300	Zinc	540
Kaolin	20,000	Mercury (lb)	6,760
Dolomites	2,000	Gold (oz)	433,947
Feldspar	15,000	Silver (oz)	134,331
Iron ore	655,000	Platinum (oz)	21,966
Magnesite	300		

CHILE

A dry winter last year in Central Chile has adversely affected the supply of water to several mills in the zone and some of them have been compelled to reduce tonnages treated. At least one has been obliged to truck water to the mill in order not to reduce the tonnage treated any further.

The Administration has authorized several mining companies to export iron ore valued at $9,934,000 in 1961. Bethlehem will export ore valued at $2,188,000 and Cia. Minera Santa Fe and Cia. Minera Cerro Imán, 1,518,000 metric tons of iron ore.

Mr. Charles Brinckeroff in a press conference held in Santiago announced the following mining news:

1) That Chuqui is producing normally at the rate of 25,000 tons of copper per month and El Salvador is below capacity at 6500 tons instead of 9000 tons per month.

2) Anaconda has invested in Chile, in the last five years, $170-million. Of this total, $60-million have been spent in housing projects and a hospital in Chuqui and $110-million at El Salvador.

3) The U. S. copper companies have not yet arrived at an agreement with the

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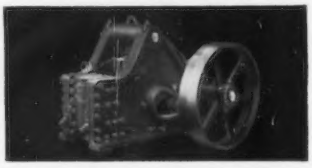
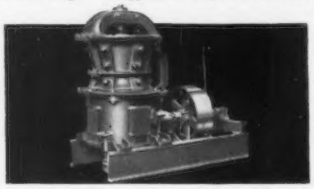
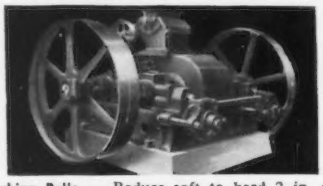


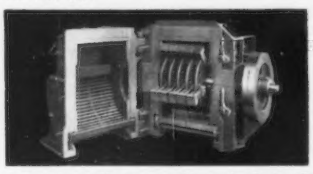
Jaw Crushers — Produce coarse (5 in. largest model) to fine (⅛ in. smallest model). Eight models range from 2 x 6 in. jaw opening (lab model) to 12 x 26 in. Capacities to 30 tph. All except two smallest sizes operate on double cam principle — crush double per energy unit. *Request Bulletin No. 062.*



Rotary Fine Crusher — Reduce soft to medium hard 3 to 8 in. material down to ¼ to 1¼ in. sizes. Capacities up to 30 tph. Smallest model has 6 x 18 in. hopper opening; largest, 10 x 30 in. Non-clogging operation. Single handwheel regulates size. *Request Bulletin No. 063.*



Crushing Rolls — Reduce soft to hard 2 in. and smaller materials to from 12 to 20 mesh with minimum fines. Eight sizes, with rolls from 8 x 5 in. to 38 x 20 in.; rates to 87 tph. Three types — Balanced Rolls; Plain Balanced Rolls; Laboratory Rolls — all may be adjusted in operation. *Request Bulletin No. 065.*



Hammer Mills — Reduce to 20 mesh. Swing-Sledge Mills crush or shred medium hard material up to 70 tph. Hinged-Hammer Pulverizers crush or shred softer material at rates up to 30 tph. Four Swing-Sledge Mills with feed openings from 6 x 5 in. to 20 x 30½ in. Four Hinged-Hammer Pulverizers with feed openings from 12 x 12 in. to 12½ x 24 in. *Request Bulletin No. 084.*

**Reports Manager W. Carleton Merrill concerning Sturtevant Swing-Sledge Mill at James F. Morse Co., Boston.*

STURTEVANT MILL COMPANY
101 Clayton St., Boston 22, Mass.

Administration about the so-called referendum to invest $400-million in Chile, but Anaconda has presented to the Copper Department two projects to invest about $10 million in machinery for the mine and mill at Chuqui and for housing at Potrerillos.

4) Studies will be continued to build an electrolytic refinery at Chañaral at a cost of about $15-million.

Cerro de Pasco will start in September to drive the 6 kilometer (3.75 miles) main haulage tunnel at its Rio Blanco copper property. Rio Blanco is located near the town of Los Andes, Aconcagua Province, which is the starting point for the Transandean railroad from Chile to Mendoza in the Argentine.

IN AFRICA

Manufacture of synthetic diamonds on a commercial scale has been announced by de Beers Consolidated Mines, Ltd. in South Africa. A subsidiary, Ultra High Pressure United, Ltd., is said to be "well advanced" in construction of a plant near Johannesburg, and production is expected in the second half of the year.

The new production is scheduled as a possible source should supplies from the Congo be interrupted. Production will be on a relatively small basis as long as the Congo supply remains normal. The size produced is comparable to the abrasive diamond grit type, used to make grinding wheels.

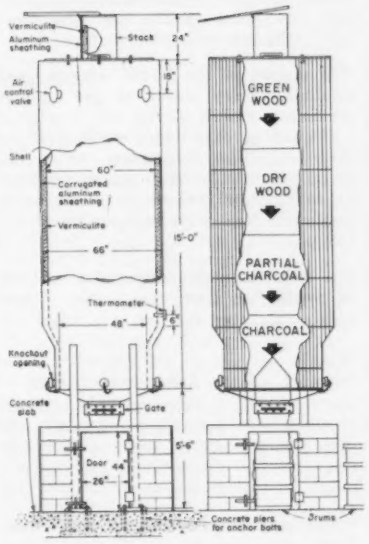
Stephen Tolbert, Liberian secretary of commerce and agriculture, has announced that, for the first time in his nation's history, iron ore shipments in 1961 will exceed rubber output in value returned to Liberia.

Some 3.7-million tons of ore, with a value of $40-million will be shipped this year. Major contribution to the important rise in shipments will be the addition, next month, of ore from the Mano River concession of National Iron Ore Co., Ltd., which is expected to be shipping 5-million tpy within three years. Up to the present, only the Liberian Mining Co. at Bomi Hills has been an important shipper.

Additional output is expected in 1963-64, with the opening of two other projects: the Lamco Joint Venture, which will mine Mt. Nimba, and the Delimco (originally Deutsche-Liberische Minen), a $125-million project now under construction in the Bong Hills. The latter is expected to produce 5-million tpy and the former 12-million.

This year Rhodesia Broken Hill Development Co., an organization in the Anglo American group, is due to complete its $12-million scheme to install an Imperial Smelting Furnace which is expected to lower production costs, improve lead and zinc recovery from about 60% to 85%, and enable the mine to recover about 200,000 tons of lead and zinc from accumulated high-grade oxidized stocks, which cannot now be treated economically.

Opportunity for Mining Companies



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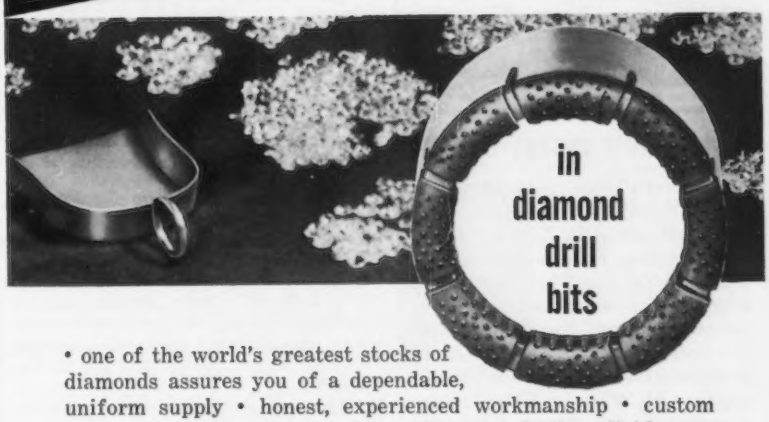

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Most of the construction is scheduled this year and it is expected that the plant will be operating early in 2962, says Harry Oppenheimer, chairman of the Anglo American Corp.

The total of proved and indicated ore reserves in this Northern Rhodesian property have risen in the last year from 5,870,700 tons to 6,380,700 tons.

The output of the South African gold mining industry soared to yet another all time record in March with a total of 1,876,123 oz. The value of this output is $65.8-million. This makes the value in output for the first quarter of 1961 up to $193,200,000 which is $12.6-million more than in the comparable period last year.

The following table shows the increase of production from the South African gold mines over the past five years:

March Quarter	Oz.	Value
1957.....	4,100,000	$143,000,000
1958.....	4,200,000	153,000,000
1959.....	4,600,000	162,000,000
1960.....	5,200,000	180,000,000
1961.....	5,500,000	193,000,000

Winkelhaak Mines, one of the Union Corp. properties in the Eastern Transvaal, has ordered plant to increase the mill capacity from slightly more than 90,000 tons a month to 105,000 tons a month. The equipment should be ready during the course of this year, the consulting engineers report.

Two underground boreholes at the Doornfontein Gold Mine, a Gold Fields mine in the Carletonville area of the Western Transvaal, have revealed that the Carbon Leader Reef extends at least 2000 ft further west at one point than the line where it has hitherto been thought possible that this reef sub-outcropped.

Values of 453 in. dwt and 50 in. dwt (with some loss of core owing to grinding) are reported for these two boreholes drilled from 15 level footwall drive west, which has been driven to explore the area west of the estimated sub-outcrop of the Carbon Leader.

If development results on the Ventersdorp Contact Reef at Western Deep Levels — the Anglo American mine in the Western Transvaal — continue to be as promising as they have been, and if a sufficiently large orebody can be developed during 1961, production at the mine may well start some months earlier than the target date — the third quarter of 1962.

The results obtained from development, boreholes, shaft intersections and cross-cuts have shown that the Ventersdorp Contact Reef in the vicinity of both shafts is well developed and mineralised. Around the No. 3 shaft, good values persist over an appreciable area.

Negotiations to set up an aluminum smelting industry at a capital cost quoted as about $10-million in the Central African Federation began in March. The company concerned, Aluminum Industrie A.G.

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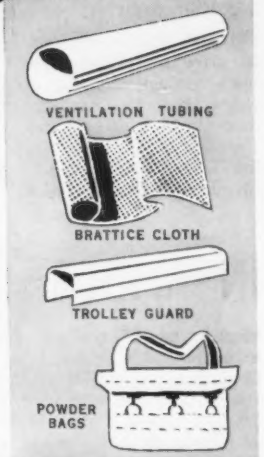

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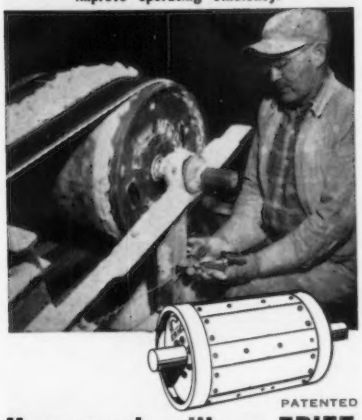

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Chippis, has headquarters in Zurich and connections in the United States, Belgium, Austria, Germany and Italy.

The Federation's present bauxite production is not sufficient to support an enterprise of any size although extensive improved deposits exist in Nyasaland. Present discussions involve the import of bauxite from Guinea and would rely largely on cheap power from the Kariba Hydroelectric scheme on the Zambesi River.

For the first time in the African Republic of the Sudan, magnetite ore will be mined as a commercial undertaking. A Yugoslav, a Sudanese, and a Lebanese firm have formed a joint venture to develop and export magnetite ore deposits in northeastern Sudan at an open cut mine nine miles west of the Red Sea port of Marsa Oseif, about 150 miles north of Port Sudan.

A local Sudanese firm last year obtained a prospecting license from the Sudanese government to develop magnetite mines in northeastern Sudan, and then contracted Jugometal, a Yugoslav import-export concern for ores and alloys, and Khabbaz Bros. & Co., a Lebanese shipping and transport firm to carry out the project. A Jugometal spokesman told E&MJ in Beirut they had tentatively scheduled operations to start in August 1961, and hoped to export 200,000 tpy of magnetite ore from Marsa Oseif.

A copper-nickel-cobalt-sulphide deposit has been discovered at Mhlambanyati in the British protectorate of Swaziland. Geological mapping of the area is in progress. New interest is being awakened in the territory as a result of the development of the rich and extensive iron ore deposits at Bomvu Ridge.

PHILIPPINES

Japanese engineers have made a thorough investigation of the iron ore deposits controlled by Surigao Consolidated in Zamboango and are ready to contract for the ore. Reserves are estimated at over 10-million tons. The same company is developing two other areas in Zamboango del Sur for copper and laying foundations for a mill. In the San Clemente area, in Tarlac, a promising copper showing is being drilled, as well as a copper-gold prospect about 10 kilometers north of the Davao Gold mine.

Samar Mining Co. has contracted to deliver 960,000 tons of iron ore, valued at nearly $10-million, to Japanese steel mills over the next two years.

Lepanto Consolidated had a production of 2,273,000 lb of copper and 3862 oz of gold in March. In 1960 the company's metal sales exceeded 30 million pesos, an increase of 62% over 1959. Higher prices for copper and gold and a more favorable exchange rate were responsible for the increase.

Marinduque Iron Mines reports that combined gross value of production from

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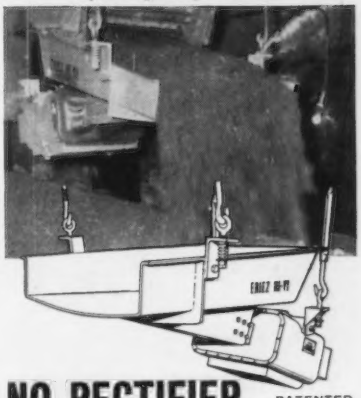

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Philippines *(Continued)*

its two properties in March amounted to $738,000. From the Sipalay property 112,000 tons were milled, averaging 0.8% copper. A small amount of by-product molybdenum was also obtained.

Atlas Consolidated milled 332,500 tons at its Toledo mill in March, from ore averaging 0.58% copper. Total production for the month was estimated at 3,502,000 lb of copper. Dan Lewis is general mine superintendent and Mose Kelly is general manager of the property which is controlled by Soriano & Co.

Itogon Mine in the Baguio area is operating its 650 ton gold mill at capacity, but is faced with the problem of low grade ore and increased costs. Ore reserves are being depleted and now total about 292,000 tons. About 872 men are employed. A better picture is presented at the Suyoc mine in the Mancayan district operated by the same company with a 350-ton flotation and cyanide mill. Ore reserves have been increased to over 328,000 tons of $15 grade. It is planned to increase mill capacity to 400 t.p.d. C. E. Fertig is general superintendent for both properties and R. E. Hall is general mill superintendnet.

Consolidated Mines, a major producer of refractory grade chromite ore, had sales of 28.7-million pesos in 1960, its best year on record. Total ore reserves are estimated at over 5.6-million tons. In March the company shipped 39,200 tons of chrome ore, valued at $1.1-million to U.S.

Philex Mining Co. milled 58,000 tons of disseminated copper ore at its Santo Tomas plant in March, producing 1411 tons of concentrates estimated to contain 724,000 lb of copper. A large slide in the mine's open pit will halt production temporarily. Henry A. Brimo is president of the company, as well as of Baguio Gold, a nearby gold producer in the Baguio area.

IN EUROPE

ENGLAND

An 1850-ton, $2.5-million walking dragline machine being built by Ransomes and Rapier, Ltd., Ipswich, will be capable of stripping its own weight of overburden each hour. A 25-cu-yd bucket at the end of a 303 ft fabricated lattice boom will strip up to 30 tons of material each "bite."

The machine is being built at the Roxby open-pit iron ore mine at Scunthorpe, a property of the Ore Mining Branch of the United Steel Companies, Ltd. Designated the Rapier W1800, the machine's revolving superstructure is supported on a 55-ft dia circular base, which in turn bears on two side-mounted walking shoes, each 55-ft long and 9.5-ft wide. The shoes are carried on vertical legs which are driven by eccentrics, enabling the machine to "walk" in 7.5-

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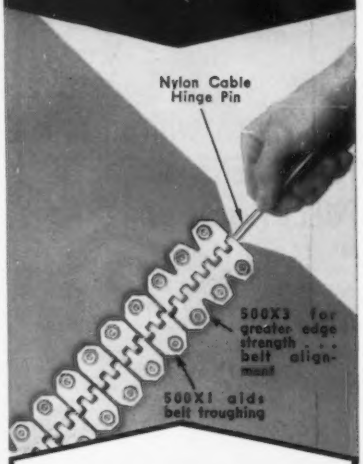

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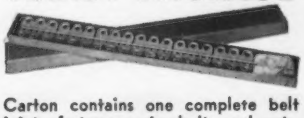

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Overburden at the Roxby mine varies in depth from 50 to 150-ft. When the W1800 walking dragline goes into operation early in 1962, overburden removal will be double its present rate of 5000 tons per week.

USSR

A group of Ukranian engineers has designed an oxygen rock-drilling unit capable of penetrating more than 25 feet per hour. Several of the new units, which employ 3000°-C flame jets to burn through rock, are said to be in operation in the Krivoi Rog iron mines.

Soviet experts recently used 500 tons of explosives to excavate a canal needed to drain off the waters of a lake and thereby gain access to bog-covered nickel deposits.

The explosion, according to PRAVDA, took place in the hills of the Kola peninsula in the Northern USSR, where nickel deposits had been found near the village of Nikel.

The 500-ton blast moved 3.5 million cubic meters of earth, resulting in a 22 to 29 foot canal, the Soviets say.

Use of the Soviet Union's first automated installation for production of metallic antimony promises to increase that rate of metal extraction from ore by at least 20%.

At the southern mining combine in Kirghizia, antimony ore is fired in the fluidized bed at a temperature of more than 1000° C. All antimony compounds in the ore are sublimated and converted to lower oxides from which pure antimony can easily be obtained, according to a TASS account.

The Soviets claim the new installation makes it possible to extract from oxidized ores, a step which "heretofore has not been achieved anywhere in the world."

HUNGARY

Manganiferous cyclone concentrates with 23-26% manganese content are being produced from the manganiferous slimes of the ore-dressing plant in Urkut; due to its poor quality the concentrate can be sold only as a manganiferous and ferriferous metallurgical fluxing material at a moderate price.

Flotation tests were conducted to enrich this cyclone concentrate, a preliminary condition being the desliming of

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Hungary *(Continued)*

the feed to a high degree. The cyclone concentrate contains large quantities of pyrolusite prone to decay and to form slime. An injector instead of a pump is used to prevent slime formation; this feeding procedure being patented and performed by means of a rubberlined hydro-cyclone.

Good results were obtained with oleic acids as collecting reagents in the 25 flotation tests conducted; sulphate soaps were found to be less efficient. The proportion recovery and the composition of the gained product were determined.

With a 15-20% weight recovery, a final product was obtained corresponding in grade to first-class coarse ore, with the advantage however that it silica content is only one-third that of coarse ore. This concentrate, therefore, can also be used to best advantage for the production of ferromanganese.

IN ASIA

The first geological map of Asia has now been completed under the sponsorship of the United Nations Economic Commission for Asia (ECAFE) in cooperation with the Commission for the Geological Map of the World of the International Geological Congress.

The need for a map of this kind was first expressed by Asian countries at ECAFE's Regional Conference on Mineral Resources Development held in Tokyo in 1953. At that time, Asia was the only continent that did not have a regional geological map. It was considered that such a map would be not only of scientific interest, but also of practical value to those interested in the development of mineral resources of Asia.

INDIA

The ore processing and handling plant of the Government-owned Hindustan Steel Corp.'s iron mine at Barsua in the south east Indian state of Orissa has gone into operation.

Said to be the biggest of its kind in Asia, the plant was designed and set up by the U.S. firm, Hewitt-Robins Inc. The Barsua mine, located in dense forest country, where former Maharajas of Orissa used to hunt big game on elephants, reportedly is among the world's richest in iron content. The plant now in operation is capable of handling 700 tph and provides crushing, screening, storage facilities and a conveyor belt system. The conveyors carry the ore over a distance of two miles which includes a vertical drop of 1300 ft from the top of a mountain to the valley below from where the ore automatically is loaded and sent on its way to the German-engineered Rurkela steel mill 55 miles away.

In installing the plant, U.S. engineers had to haul supplies and equipment over extremely difficult terrain by means of trailers. The excavation for the crushing station on a 2600-ft mountain-top, for instance, necessitated considerable cutting and blasting through solid rock and after the excavation, the crushing station, 150 feet high, had to be anchored to the steeply sloping side of the mountain. The construction of the conveyor belt over a deep gorge also was considered another technical triumph.

An agreement has been signed between Montecatini and the Madras Aluminum Co., Ltd. for a 10,000-tpy aluminum plant in the state of Madras in southern India. The plant will produce aluminum ingots and alloys from local bauxite ores. Montecatini will design the new installations and will supply complete technical know-how and assistance.

Madras Aluminum Co., Ltd. was established through the joint participation of the Indian government, private groups and Montecatini and with the special promotional assistance of R. Venkataswamy Naidu, a leading industrialist.

JAPAN

A three-year contract for the importation of 13.4-million tons of iron ore from the Eastern Mining and Metals Co. of Malaya has been signed by nine Japanese blast furnace operators. The group is already tied in a one-year contract with the Malayan mining company to import 2.8-million tons this year.

The new contract calls for delivery of 9.4-million tons of Dungun ore and 4-million tons of Rompin ore.

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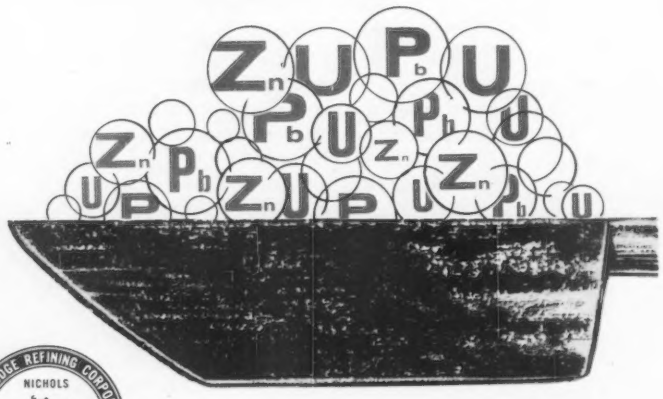

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In reply give complete details and references.

P-6697 Engineering and Mining Journal
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One to five years experience; preferably in milling or research. Work in head office of mining supplier, New York area. Duties to include liaison with field sales force, research, production and customers.

State salary required.
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Sales Engineer—Excellent opportunity for right man with growth company. Submit complete resume with salary requirements. P-6821, Engineering & Mining Journal.

Mining Engineer for high level planning and control of mining and processing activities for expanding large iron ore mining company in South America. Minimum 10 years experience in open pit and underground mining. Working knowledge of Spanish essential. P-6772, Engineering & Mining Journal.

Experienced mining engineers needed for open pit iron ore project in West Africa. Submit resumes to Associated Mine Services, Inc., 70 Pine Street, New York 5, N. Y.

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POSITIONS WANTED

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Manager or Superintendent, B.S. in Mining Engineering; extensive experience in coal and metal mining; excellent cost control and production record. Presently employed as manager of a coal company. Wish to make a change to nonmetallic industry, such as potash, salt, etc., using coal mining equipment and methods. Available after suitable notice to present employer. PW-6695, Engineering & Mining Journal.

Geologist MS, Chemistry BA, from leading Universities, single, age 31 with commercial pilot license and own Cessna 180 desires full or part-time position with mining or mineral exploration company or consultant firm. Also has experience in glaciology and snow research. PW-6699, Engineering & Mining Journal.

Mining Geologist: Recent M.S., 37, single, experienced in mining and exploration geology in Alaska and Latin America. Speaks Spanish, desires foreign work. Box 5144, Eugene, Oregon.

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Surveyor, Draftsman, Surface & Underground maps, calculations, plane table. PW-6820, Engineering & Mining Journal.

Sr. Mining & Metallurgical Engineer, solid U.S. and foreign background in underground mining and civil engineering; designing, constructing electric smelting plant, 1,000 ton concentration mill beneficiation chromite), 5,000 ton cyanidation mill (flotation & concentration); power stations, roads & townsites, exploration, geology, surveying, reports; seeks responsible and stimulating position. PW-6384, Engineering & Mining Journal.

General Manager or Executive Assistant. Capable, responsible, with 14 years diversified management experience. EM degree. Exceptional record in major cost reduction program. Fully experienced in operations, development and exploration. Good nose for ore. Locate anywhere. Resume, interview—available now. PW-6606, Engineering & Mining Journal.

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For Sale or Lease—600 choice, select, patented mining claims in the precious metal mining district of Silverton, Colorado. Metallurgists say there is enough manganese (rhodonite) to pay mining and milling expense of a 3,000 ton per day mill operation. Gold, Silver, Lead, Zinc, Copper, etc., will be net profit. Lease only to competent mining corporations. Sale at cost of patent and taxes already paid. Merrill Ross, Box 1835, Durham, N. C.

Wanted—Powellite deposit capable being mined with power shovels. Prefer large deposit of Powellite containing at least 0.50% WO_3 and least 0.50% Mo. Bank references furnished. Address P.O. Box 1022, Reno, Nevada.

8 Mining Claims—Gold & Silver. New discovery, merits development, located 1953. Little Rocky Mining District, Little Rockies. Invite inspection, Henry Heppner & Harold Heppner Owners, Landusky, Montana.

Flourspar Mine and Mill for sale or lease in Arizona. Write J. Marcil, 16711 Glenburn, Torrance, Calif.

Tellurium Deposit Wanted—Prefer power shovel operation but will consider underground if tellurium percentage is high enough. Address P. O. Box 889, Reno, Nevada.

FOR SALE

Barite for Sale—ton, lease or sale of deposit. Lump chemical grade, 97% $BaSO_4$, low impurities. Mine run 4.2-4.45 sp. gr. Economically located and suitable for Alaskan and Arctic oil well drilling areas. Donald Kotschevar, Sandpoint, Idaho.

EQUIPMENT HEADQUARTERS—USED MACHINERY

AGITATORS
2—4′x5′ Wemco, wood tank, 1½ HP
2—25′x20′, Steel tank, 30 HP
1—S-3 "Lightnin", portable, 440 V.

BLOWERS
1—12-20 Sutor bilt Rotary Positive Press.
1—22″x38½″ Roots Rotary Positive, 150 HP, 220 V.
1—#6, Size 20″x36″ Roots Rotary Positive, 150 HP

CLASSIFIERS
2—60″x20′ Akins Spiral, std. weir, 5 HP
1—3″ Correlone, VRC
1—EE10-4B Krebs Cyclone

COMPRESSORS
1—475 cfm Joy WG-9 12x9, 80 psi
1—2500 cfm Sullivan Class WN4, 2200 Volt
1—950 cfm I. R. XLE-2. 170 HP.
1—15,000 cfm Ingersoll-Rand PRE, 1450 HP.

CONVEYORS
1—60″x150′ Conveyco, Lattice Frame 100 HP
1—42″x1250′ Link Belt, Steel Frame 2-100 HP
1—36″x645′ Link Belt, Steel Frame 2-100 HP
1—42″x870′ Link Belt, Steel Frame 100 HP
1—30″x490′ Jeffrey, 52H, Steel Frame 15 HP
1—30″x450′ Jeffrey, 52H, Steel Frame 15 HP
1—30″x350′ Jeffrey, 52H, Steel Frame 15 HP

CRUSHERS
1—4′ Symons Std. Cone, Fine bowl, 125 HP 440 V.
1—4′ Symons Std. Cone, Coarse bowl,
1—30″x60″ Penna., Single Roll , 100 HP.
1—10″x30″ Pacific Jaw, 40 HP

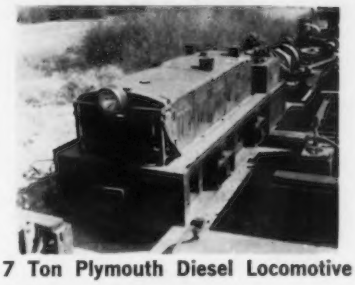
DREDGE
1—6 cu. ft. Yuba, Electric, Year 1954

FEEDERS
1—36″x15′ Link belt, Steel pan 3 HP
1—30″x13′ Sliding belt, 1½ HP. Excellent
8—8″x36″ Jeffrey vibrating 2DH, 110 V.
1—10″x36″ Jeffrey vibrating, 2AHD 110 V.
1—30″x60″ Syntron vib. F45A, 440 V.
1—GF-22-24 Syntron "Gravimetric"
1—30″x48″ Jeffrey Vib. 4H, 440 V.
1—24″x72″ Jeffrey Vib. 4H, 440 V.
1—24″x72″ Jeffrey Vib. 4, 440 V.
1—30″x60″ Jeffrey Vib. 4D. 440 V.
2—60″x16′3″ Pioneer-ORO, Apron, 20 HP 440 V.

FILTER
1—6′ dia x 6 disc Eimco, Vac. pump, complete

FLOTATION MACHINES
1—4 cell 16″x16″ Denver, "Sub A"
1—6 cell #21 Denver "Sub A"
1—8 cell #18 Special Denver "Sub A"

HOISTS, TUGGER & SLUSHER
1—FF311 Joy 3 drum, 10 HP 440 V.
2—CF-211 Sullivan Slusher, 50 HP. 440 V.
3—10NNIG Ing. Rand, 2 drum, 10 HP 440 V.
7—FF211 Joy, 2 drum, 10 HP 440 V.
10—HB Gardner Denver, 1 drum, Air, 1250#



7 Ton Plymouth Diesel Locomotive

8—L-111 Joy 1 drum, Air, 2000#
10—HU Ing. Rand, 1 drum, Air, 2000#

HOISTS, MINE SHAFT
1—165 HP Denver Engineering, 2 drum, 440 V.
1—100 HP Denver Eng., 1 drum 440 V.
1—150 HP Vulcan-Denver, 1 drum, New
1—600 HP Vulcan Wilkes Barre, 2 drum, 2300 V.
1—675 HP Vulcan Wilkes Barre, 2 drum, 2300 V.
1—125 HP. Puget Sound, 1 drum, 6500# pull, 440 V.

HYDRO SEPARATORS
1—36′x10′ Process Engineers, Steel tank
2—24′x8′ Process Engineers, Steel Tanks

JIGS
1—12″x18″ Denver Duplex, Mineral
1—16″x24″ Denver Duplex, Mineral
12—42″x42″ Yuba, M-8, 4 cell

LOCOMOTIVES
4—1½ ton Mancha "Little Trammer" 18″-24″ ga
1—4 ton Mancha "Electric Mule" 24 ga
1—8 ton Plymouth Diesel, DHD, 24″ ga
1—6 ton Mancha "Std AN," Battery, 24″ ga

MAGNETS
1—24″x24″ Magnetic Pulley 250 V. DC
1—24″x30″ Dings Magnetic Perma-Pulley

MILLS
1—7′x48″ Hardinge Conical, Lg. Trunnion, 150 HP
1—7′x22″ Hardinge Conical, Lg. Trunnion, 75 HP
1—7′x36″ Hardinge Conical, Lg. Trunnion, 100 HP
1—7′x5′ Allis Chalmers, grate type, 150 HP
1—5′x10′ Marcy, overflow, 100 HP

MUCKING MACHINES
1—#21 Eimco Rocker Shovel, 48″ ga. Incline Type
2—#21 Eimco Rocker Shovel, 24″ ga
2—#12 B Eimco Rocker Shovel 24″ ga

PRESS
2—Size 30, Sperry Filter, 30″x30″

PUMPS
1—2GT Ing. Rand 50 HP 440 V.
2—1MRVH-7½ Ing. Rand 7½ HP, 440 V.
1—1MRVH-15 Ing. Rand 15 HP 440 V.
2—2MRV-25 Ing. Rand 25 HP 440 V.
2—5RVL-30 Ing. Rand 30 HP 440 V.
2—16″ Cascade Sump, 7440gpm, 30 HP
1—2″ Denver Equip. Simplex Diaphram
1—6″ Fairbanks Morse, 300 HP Regutron Control
2—14″ Yuba, Model AA, 250 HP 5500gpm
1—10″ Yuba, Model S, 2400gpm
1—16″ Wintroath Deepwell, 100 HP Regutron Control
2—8″ Dorrco Duplex, Type W, 5 HP
3—6″ Dorrco Duplex, VM, 3 HP

VACUUM PUMPS
2—18″x6″ Ing. Rand ER-1 15 HP 440 V.
1—17″x10″ Chicago Pneumatic NISB 25 HP

SAND WHEELS
4—12½′x4′ Conveyco Duplex, 20 HP

SCREENS
1—41″x66″ Jeffrey-Traylor, F8-2, 1 deck, MG set
1—9′ dia x 54½′ Yuba, Trommel, 100 HP
3—4′x12′ Tyler Tyrock, 1 deck 10 HP
3—6′x14′ Hewitt Robins, MH-11, Scalping
2—6′x12′ Allis Chalmers, Lowhead
1—4′x8′ Tyler Hummer
1—4′x10′ Tyler Hummer

SEPARATORS WITH RECTIFIERS
1—HS-218 Carpco, High tension
4—HT-460 Carpco, High tension
3—MI-418 Carpco, Magnetic
1—HS-418 Carpco, High tension
1—Memco-Hope, 16½′x12″, 3 cross belt
1—30″x75″ Stearns Mag. Drum, type WPD

SHOVELS
1—20B Bucyrus Erie W/dragline
1—111M Marion Diesel Electric W/3½ yd Dragline
1—54B Bucyrus Erie Dragline
1—170B Bucyrus Erie, 7 yd. Electric

THICKENERS
1—100′ Dorrco Traction, 3 HP gearmotor
1—120′ Dorrco Traction, Type IC, 5 HP

TIMBER FRAMER
1—Stearns Roger Single End, 440 V. Exc.

TRACTORS
1—75A Michigan Loader Waukesha Gas
1—105 Eimco, Angle Dozer, Carco winch
1—105 Eimco Excavator

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1—15 ton Mack Off Highway, Model LRX

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1—18″ Merrick, Model E, w/Rateograph

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2—Louisville SS rotary dryers, 8'x50', complete
6—Rotary dryers, 2 tires, ⅜" shell, complete, 7'x60', 6'x64', 6'x56', 6'x35', 4'x20'
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Allis Chalmers Rolls (crusher) 24"x14", 20 h.p.
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Wemco Remer Jig, 5'x16', two 7½ h.p.
Wemco Classifier, 36"x19'3", 3 h.p.
Wemco Model C Solids Pump, 3", 15 h.p.
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1—80 CFM Worthington
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1—105 CFM Davey with 25 HP Motor
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1—278 CFM Ingersoll-Rand
1—365 CFM Gardner-Denver Diesel Engine Driven
1—365 CFM Chicago—Pneumatic Diesel, Portable
1—447 CFM Ingersoll-Rand
1—445 CFM Gardner-Denver, Model WBH, with 75 HP Motor
1—100 HP Ingersoll-Rand Imperial Type
1—637 CFM Sullivan Type WJ3, with 125 HP Motor
1—660 CFM Sullivan, Model WN-102, 11¼" & 7" x 7"
1—759 CFM Ingersoll-Rand Imperial, 21" & 12" x 16"
1—1085 CFM Ingersoll-Rand Imperial, 21" & 12" x 16"

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1—F-211 Sullivan Double Drum Air Slusher
1—F-212 Sullivan Double Drum Air Slusher
1—Joy Model S-211
1—Gardner-Denver Model HEE
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1—1½ Ton Mancha Trammer
1—4 Ton GE Type LSB-2C4
1—4 Ton Westinghouse—Baldwin
2—6 Ton General Electric, type LSBE-2C6
1—7 Ton Atlas
2—8 Ton General Electric, type LSB-2C8
1—8 Ton Goodman, type 42C04T
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4—10 Ton Atlas, type A

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2—Ingersoll-Rand Model 10HR
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2—Joy Model F113
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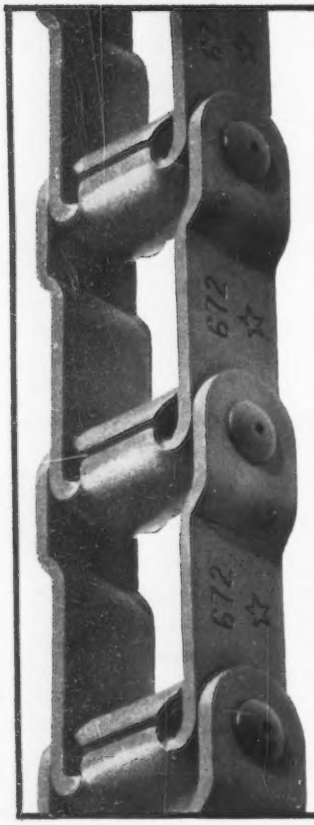

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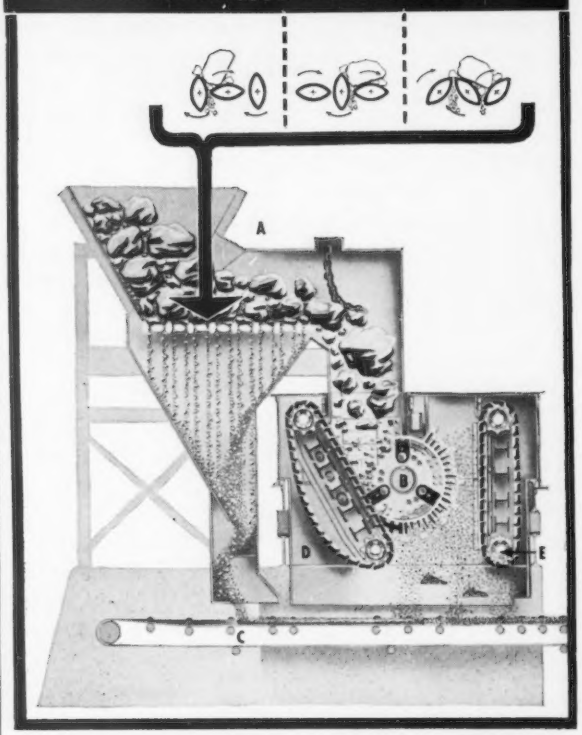

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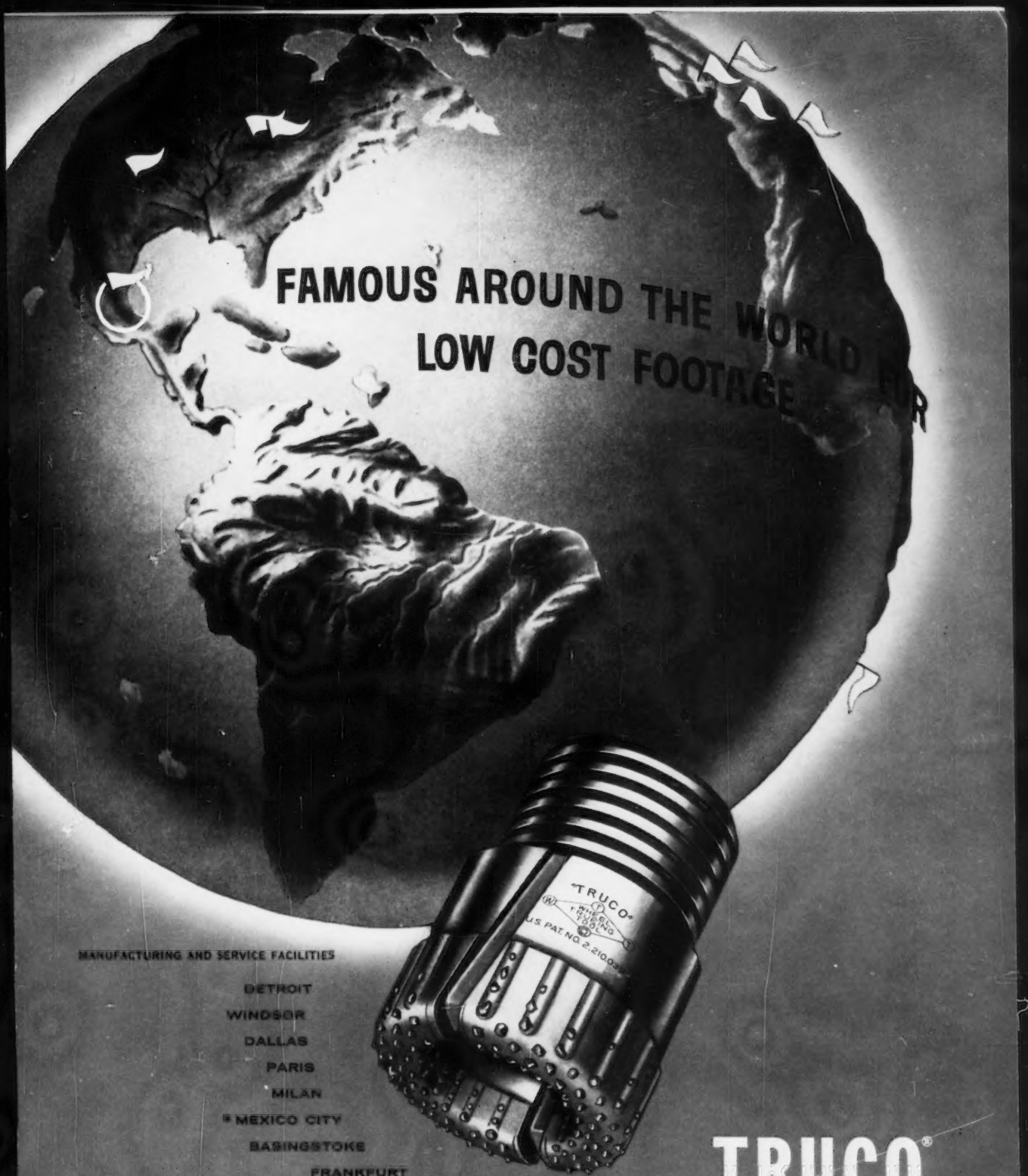

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